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NOTES AND COMMENTS.

Argon.

IN our attempt to limit the pages of Natural Science to that branch of the sciences long ago called by the French "Natural" we necessarily exclude detailed reference to chemistry and physics; still we are eager to congratulate Lord Rayleigh and his patient collaborators on the discovery of a new element. It may be long before Argon is satisfactorily investigated and assigned its appropriate place or places in the hierarchy of the elements. Indeed, the new substance seems unruly and not to be set in its place without an undue shouldering of its neighbours. What is most impressive to us now is the method of the discovery and its promise for other realms of science. It was found by no restless ranging over the face of the earth seeking out the scanty and the rare. It was gained as the direct result of more careful, exact, and patient investigation of the familiar than had been done before. A few years ago biologists were ill content with any animal not dredged from the remotest ocean, not taken in the furthest land, and many far-reaching theories were founded upon the anatomy and development of "*Outis mirabilis*," some rare organism known only from Cathay. We have no wish that such investigation should be discouraged: the remotest in Nature may yield a clue to the most familiar secret. But, as we have noticed before in these pages, the present fashion in biology is to study the familiar in new ways rather than to seek out the unfamiliar. May we hope that, as Lord Rayleigh, weighing the constituents of the air, came upon an undiscovered element, so some of those who are measuring the lengths of crabs or the variations in the shells of ammonites may come upon unsuspected truths.

But in a directer fashion Argon seems to offer promise to biology. It is a constituent of the atmosphere, and enters the lungs and the air-chambers of animals and the tissues of plants. It is twice as soluble as nitrogen, and, no doubt, actually enters that flux of substances we call the living substance. Does it leave it unchanged? Is it a casual visitor, as impertinent to the stream of life as are straws to the current of a river? Here, as soon as a convenient method of preparing Argon be found, is a field that must be explored by the physiologist. It is certain enough that the most common events of protoplasmic respiration are not known in detail so minute as to exclude the operation of unknown factors. The exact influence of Argon upon vital phenomena must be determined as soon as possible. More than this, its relation to proteids must be investigated. That is an obvious piece of work that already may be in the doing. It is true Professor Ramsay found no Argon in the nitrogen prepared from urea. But as Argon will not combine with oxygen, its absence in urea by no means excludes the possibility of its presence in proteids.

Sir Robert Ball and the Cause of an Ice Age.

The *Geological Magazine* has begun under its new publishers Dulau & Co.) with two very interesting numbers. The most remarkable paper is a criticism on the astronomical theory of the Ice Age, by Mr. E. P. Culverwell, the second part of which appeared in the February number. Mr. Culverwell's criticism of Croll's theory simply confirms the view of its absolutely untrustworthy nature, which has long been held by geologists. The most startling part of the paper is, however, his attack upon Sir Robert Ball's pretensions to have corrected and improved Croll's statement of the case. Culverwell argues that the Cambridge Professor has done nothing for the astronomical theory except misunderstand and misrepresent it. He proves that the supposed fundamental error in Croll's argument, which Sir Robert claims to have discovered "and which it is the chief object of [his] book to expose" is a mere mare's nest. Sir Robert represents Croll as saying that the heat received in summer is equal to that received in winter. This, of course, is not the case, and Culverwell quotes several passages from Croll which show that he said nothing so erroneous. In fact, in the main difference between Croll and Sir Robert, all the advantages are with the former; his statement is more correct and would account for a greater difference in climate than the theory as modified by Sir Robert. All readers of the latter's little book will remember the wearisome reiteration with which the numbers 63 and 37 are used. They are conjured with all through the book. The author gives no justification for their adoption, but declares that it is impossible to discuss any astronomical theory of the Ice Age in which these magic numbers do not form the refrain of every argument. But

these numbers, as Culverwell shows, have little or nothing to do with the subject. It would greatly enhance the value of perusal of the work among the class of readers who are influenced by it, if the publishers would print a note on the title page recommending that all passages containing the numbers 37 or 63 should be skipped. The misleading use Sir Robert makes of these numbers may be judged from his sensational description of their influence on climate. Thus he describes how the 63 measures of heat are poured in like a torrent in a hot summer of 166 days, while the 37 measures of heat are dragged out over the whole of the long winter of 199 days. This unfair division of heat, he says, brings about "a climate of appalling severity —an Ice Age in fact." But, as Mr. Culverwell points out, Dublin has a climate with a far more unequal division of heat than this, for there 22 measures of heat, instead of 37, have to do for the 199 days. In fact, to find a climate of the "appalling severity" of that described we have to go as far south as Madrid or Constantinople. Mr. Culverwell concludes his paper with a theory of his own, explaining the cause of Ice Ages as due to an increase in the amount of the earth's atmosphere. Whether this theory be accepted or not, Mr. Culverwell has certainly earned the gratitude of geologists by his complete exposure of the general weakness of the astronomical theory, and its special weakness as set forth in the rhetorical pages of Sir Robert Ball.

The Origin of the Irish Fauna.

A recent short paper on this subject by Dr. R. F. Scharff (*Proc. R. Irish Acdemy* (3), vol. iii., pp. 479-485) will be read with interest by both zoologists and geologists. The author does not explain the peculiarities of the Irish fauna by suggesting a direct ancient land-connection with the Spanish peninsula, nor does he believe that the entire animal population of the sister island has migrated thither from Great Britain by a post-glacial land-connection. His conclusions, based mainly upon the distribution of living and extinct mammals, freshwater fishes, and terrestrial molluscs, are that in Pliocene times Ireland was connected with Wales in the south, and with Scotland in the north, a freshwater lake occupying the central area of the Irish Sea. The southern connection is believed to have broken down in early Pleistocene times, and the northern soon afterwards. Those species which, though found in Great Britain, are absent from Ireland, are supposed to have entered the latter country after these isthmuses had been severed. The distribution of the lake fishes, of the genus *Coregonus*—in Ireland, southern Scotland, Cumberland, and North Wales—is the main evidence adduced in support of the Pliocene lake on the site of Irish Sea.

The most startling conclusion of the paper is that the entire Irish fauna is of pre-glacial origin. Those geologists who believe that the country was buried beneath an ice-sheet, hundreds of feet thick,

will be unable to accept Dr. Scharff's views, and may perhaps wonder that he ignores the difficulty which their theory raises. In the detailed memoir on the subject, which he promises at an early date, we may expect this and other questions to be fully discussed. Meanwhile we welcome his contribution, as a warning that theories about the past physical conditions of the earth's surface must not contradict the facts taught us by the distribution of living animals.

IRISH CAVE DWELLERS.

THE February number of the *Irish Naturalist* contains a paper by Mr. G. H. Carpenter, which is of singular interest in connection with the origin of the Irish Fauna. Zoologists remember Mitchelstown because one of its famous caves is the only one in the British Islands known to be inhabited by a member of the peculiar blind, subterranean fauna, which, through explorations of the European and North American caverns, now includes some hundreds of species. A recent visit paid to Mitchelstown by the Dublin, Cork, and Fermoy Field Clubs resulted in the discovery of several additional species, now ably described and discussed by Mr. Carpenter.

The first found was a spider of the darkness-loving genus *Porrhoma*, and not to be distinguished from the species *P. myops*, which was based on a female taken in the cavern of Espezel (Aude), in southern France, but of which another female has since been found in Dorset. A species which, from the description and figures, appears to be identical with *P. myops*, occurs in the Fountain Cave, Virginia, and in the Bat Cave, Kentucky; it has been named *Linyphia incerta*.

The species formerly known from this cave was a minute insect of the Order Collembola, doubtfully referred to *Lipura stilicidii*. Mr. Carpenter, however, finds that it differs from that species in many points, and therefore names it *L. wrightii*, after its discoverer.

The most interesting animal here described is another blind Collembolan, readily differentiated from the *Lipura* by the possession of a well-developed "spring," two-thirds as long as the body. Mr. Carpenter names it *Sinella cavernicola*, but points out that it differs from the North American spring-tail, *Entomobrya cavernarum* (Packard) only in the absence of clinging hairs from its feet.

A small mite, *Gammasus attenuatus*, and an earthworm, *Allurus flavus*, the latter found near the entrance, complete the list.

Of these animals, the arachnids are bleached and the insects perfectly white. The latter are also blind, and the eyes of the spider are degenerate. The mite is blind, too, but then it belongs to a blind family.

The amount of food forthcoming in such a habitat is not great. Spring-tails live on vegetable refuse as a rule, and those found here extract what nourishment they can from the fine, moist, red clay that

carpets the cave, although it cannot contain much organic matter except what may be brought in by water or produced by the disintegration of some of the lower fungi. The spring-tails themselves form the food of the mites, while mites, spring-tails, and all, are apparently a prey to the spiders. These spiders do not seem to spin webs as do all their next-of-kin, but walk about seeking whom they may devour.

The wide geographical distribution of these cave-dwellers is, says Mr. Carpenter, a truly remarkable phenomenon, especially as the caves can be of no great geological age, and there can have been no migration of subterranean animals between southern Europe and Ireland, or between Ireland and North America, within any period during which the fauna can have been specifically identical with that of the present day. Mr. Carpenter, therefore, concludes that "from ancestors, presumably of the same genus, which took to an underground life in such widely-separated localities, the similar conditions of the caves have evolved descendants so similar that, when compared, they cannot, or can hardly be, specifically distinguished from each other. Should the identifications suggested in this paper stand the test of a comparison of types, we shall have proof that the independent development of the same species, under similar conditions, but in widely-distant localities, has taken place. It must be granted, however, that cave conditions are so marked and exceptional, that it might not be safe to argue from them as to what may have occurred in the upper world."

It is to be hoped that this suggestive paper of Mr. Carpenter's may evoke fresh search for cave-dwellers in other parts of the British Isles, especially in the limestone caverns of Ireland.

"The Geologist at the Luncheon-Table."

We cannot close our copy of the *Irish Naturalist* without alluding to a really charming little paper by Mr. Grenville Cole, with the above title. In a writer gifted with a less pleasing style we might resent this imitation of the dearly-loved Autocrat; but Mr. Cole's stylograph is filled with a humour and a geniality not unlike those that flowed from the famous gold pen of Oliver Wendell Holmes.

Those of our readers who have visited Dublin have doubtless received hospitality from their scientific brethren in the delightful refreshment-rooms conducted by the Misses Gardiner. It was a happy idea of the literary and scientific wits who frequent these rooms to make their owners a New Year's present of seven ornamental tables, whose tops of polished Irish marbles were carefully selected by a scientific committee. The little paper now before us shows what lessons may be learned from these table-tops by the geologist who may chance for a few minutes to sit solitary over his midday meal. The paper should be framed and hung up in the rooms that all who eat may read.

THE COURTSHIP OF THE SPIDER.

THE antics of the male spider during courtship are well known, largely owing to the careful observations of two American naturalists, Mr. and Mrs. Peckham. There are, however, the most diverse ideas as to the precise distance at which a spider can see a fly or a lady spider. The extremes are one-eighth of an inch on the one hand, and "three or four yards" on the other. These differences of opinion require, if possible, some reconciliation. And Mr. and Mrs. Peckham attempt this, partly by direct observation and partly by criticism. M. Plateau, to whose experiments upon mimicry and colour-meaning we referred in our last number, seems to have based his theory of limited vision in spiders upon the futile attempts which a female wolf spider makes to recover her egg-sac when it has been snatched away. According to the Peckhams, this does not necessarily go for much in the way of the desired proof. For the egg-sac is manufactured in such a position that the anxious parent has probably never seen it in her life, and only recognises it by touch. Direct experiment tended to prove this assertion. There is, too, as an instance of aggressive clearness of vision, the terrible spider of the pampas, described by Mr. Hudson, which starts in pursuit of anyone passing within three or four yards of its lurking place. Some little spiders kept in captivity darted upon a gnat when it was five inches away. But the sharpness of vision appears to be accentuated by love. A male of *Saitis pulex* was put into a box in which was a female of the same species twelve inches away; we are told "that he perceived her at once, lifting his head with an alert and excited expression, and went bounding towards her." That recognition, in these cases, really is due to sight, and not to any other sense, appears to be shown by the fact that if two spiders are back to back they do not become aware of each other's presence, no matter how close they may be. Moreover, one male, when in the ecstasy of courtship, was interrupted "by taking him out and gently blinding his eyes with paraffin. He was then restored to the box, where he remained quite indifferent to the presence of the females which had excited him so much a few moments before." But one of these males, apparently suspecting some trick, carefully cleansed his eyes from the paraffin by rubbing them with the palpi, and then began "dancing before a female three and one-half inches away." A female of a species named *Astia vittata*, observed to attract the opposite sex, was temporarily removed and painted of a bright blue; the male spiders, who had before been unremitting in their attentions, treated her with the most absolute indifference. After a few moments, however, one of them suddenly leapt upon her, but whether this was the result of hunger or of love does not appear. At any rate, the experiment seemed to argue some colour-sense in the creatures. A further series of experiments put this belief upon a firmer footing. The approach to the lair of a spider was covered with variously coloured paper, which at first

proved baffling, but was later recognised. Altogether it would appear that spiders are by no means so deficient in sight and in the power of differentiating colour as has been urged in some quarters. But whatever may be the ultimate value of Mr. and Mrs. Peckham's paper, there is no manner of doubt that it is exceedingly interesting reading. It is to be found in vol. x. of the *Transactions of the Wisconsin Academy of Sciences.*

Comparative Edibility.

With reference to the note in our February number on warning colours and edibility, Mr. O. H. Latter has kindly sent us the following observation. He writes:—"It is well-known, and I have myself observed, that all our 'Cabbage' Butterflies are immune from attacks by birds, presumably because of some unpleasant taste or smell. Wasps, however, have twice been observed by me in the act of devouring these butterflies. Earwigs, too, which undoubtedly possess an unpleasant smell when irritated, fall victims to wasps, in spite of their malodorous attributes."

The Origin of Oolite.

In the last number of Natural Science we referred to a paper by Mr. G. F. Harris on the "Analysis of Oolitic Structure"; curiously enough, a week later, Mr. E. Wethered made a communication to the Geological Society on a somewhat similar subject, only that the last-mentioned author laid emphasis on the origin of the granules. Mr. Wethered has "long entertained the opinion that all oolitic granules are of organic origin, but has not, up till now, been in a position to prove this." The class of evidence laid before the Society mainly consisted of micro-photographs of sections of pisolites and oolites, and we must say, that, like many of the speakers who joined in the discussion, we failed to see the *proofs* referred to. The first few slides shown, appertaining to pisolite, were convincing enough, if a series of vermiform tubules could be taken as evidence of the origin of the granules themselves. That these tubules are the work or the remains of organisms, few would care to dispute. But when the author desires us to see *tubules* in certain of the oolitic granules, we draw the line, and ask for further proofs. We do not suggest, for a single moment, that with the "eye of faith" they could not be detected on two or three of the slides of oolite; but it struck us that much of what we saw could be explained very well indeed as due to ordinary chemical action, while several of the structures shown and referred to as proofs of organic origin appeared to be much more like the results of alteration in the granules since they were formed. For a hypothesis to succeed, it is necessary that all the facts ascertained shall be concordant with it; we do not wish to convey the idea that the origin of oolitic granules,

wherever formed, is or has been due to one set of causes, but it is not too much to ask that granules shown in any one micro-slide shall have originated by one method. There should be no selection of isolated granules from a large number of slides, when the majority of other granules, equally clear, do not give that evidence which coincides with one's views. We are far from saying that oolitic granules are never of organic origin. Rothpletz has shown that structures somewhat similar to those found in oolite limestone are produced by fission algæ, and it may be observed that a like structure is seen in many calculi. At the same time, it cannot be ignored that perfect oolitic granules have been made artificially by purely chemical means, and "oolitic granules" are not unknown to be forming under conditions totally unlike those described by Rothpletz and others. If Mr. Wethered had contented himself with drawing attention to the similarity of some of the granules exhibited by him to those of the Great Salt Lake mentioned by Rothpletz and described by certain American authors, we should have nothing to say; but when he asks us to recognise systems of tubules running concentrically round the nuclei of granules, and others radiating from these nuclei, we think he is demanding too much—especially with reference to the "radiating tubules." We are not of those who believe that, in order to show the organic origin of the granules, it is necessary to prove the existence of tubules, though, of course, when these can be satisfactorily demonstrated, they add interest to the problem. We are pleased to see, however, that this difficult subject is receiving the attention it deserves, and have no doubt that the researches of Mr. Wethered and others will do much towards its ultimate satisfactory elucidation.

Peridotites and Phosphates.

That close and painstaking observer, Mr. T. H. Holland, who so recently distinguished himself by his work on the Gohna landslip, has returned to the less exciting details of Indian igneous rocks. In two papers in the *Records of the Geological Survey of India* (vol. xxvii., pp. 129–146) he describes certain peridotites from Bengal. It is quite refreshing to be provided with a summary of the literature poured out upon this timid and retiring group of rocks at a time when they were a prevailing fashion—say, in 1885. We fancy that a somewhat pale biotite is commoner in peridotites than Mr. Holland supposes; but his phosphatic series from the Lower Gondwana rocks is a distinct addition to our knowledge. In some of these apatite is so abundant, in characteristic rod-shaped crystals, as to have been mistaken by a previous observer for felspar, and as to form a near approach to ophitic structure in the larger crystals of biotite. These rocks are intrusive in coals in a manner that suggests the possibility of the occurrence of diamond as a contact-product, since, as Mr.

Holland points out, that attractive mineral seems connected with the junction of peridotites and carbonaceous rocks. We believe, however, that at Kimberley the diamonds are still forthcoming, although the neck of ultra-basic rock has been worked down into the granite that underlies the shales. No diamonds have yet been found in connection with the Indian peridotites, so that their interest is for the present somewhat esoteric. Even the large quantity of phosphoric acid, present in the form of apatite, is not enough to render the rock of economic value. Not only does the apatite withstand decomposition longer than all the other constituents of the rock, with the exception of the biotite, but "even the richest form would be poor compared with the basic Bessemer slags, and the use of these has been attended with indifferent success."

Fortunately, the world has as yet no need for a fresh source of the fertilising phosphates. From the *Revue Scientifique* we learn that a wide band of phosphate of lime, 70 or 80 kilometres in length, runs right through Algeria and extends into Tunis. Its richness is remarkable, and the supply is enough to furnish the whole of Algeria and Europe into the bargain. At Tebessa, not far from the frontier of Tunis, the phosphate is already being worked, and it is estimated that there are in the quarries a hundred million tons of this precious food for cereals. France is to be congratulated. But, alas! even here she is not safe from the perfidious and enterprising Albion. Of the three concessions at Tebessa, two are already in the hands of British companies, who pay a royalty of only 50 centimes per ton. As the market price of the phosphate is 40 francs a ton, it can be sold on the London market at a profit of more than 20 francs per ton. Here is a grand opening for the Socialists to spring another attack on the President of the Republic, and to furnish the papers once more with the familiar headline, "A Scene in the Chamber."

But we must return from the stormy seas of politics and commerce to calm scientific contemplation of phosphates. France has yet other phosphates, and among them some of the most remarkable are found in pockets in the great limestone plateau that stretches from Uzès to the neighbourhood of the Rhone opposite Avignon. The limestone is of Lower Cretaceous age, being that which is called Urgonian, from the town of Orgon, near Arles. The pockets of phosphate of lime are of two kinds. In the first type the Urgonian Limestone is penetrated to a depth sometimes of 60 metres by large pockets, filled by coarse sand, with grains of flint and small phosphatic nodules of chalky consistency. The pockets also contain blocks of Urgonian flint, with the casts of such characteristic fossils as *Requienia* and *Monopleura*; but there is no trace of vertebrate bones. In the second type, narrow and irregular cracks, sometimes 20 to 30 metres deep, furrow the Urgonian plateau in all directions. They are filled by a calcareous clay of reddish colour, more or less ferruginous, and richer in phosphate than the first kind of deposit.

The phosphate is often concretionary and stalagmitic, just like the well-known phosphorites of Quercy. Like them, too, it contains, especially in the upper part of the pockets, an abundance of bones and teeth of vertebrates, belonging to the oldest Quaternary, or perhaps to Pliocene times. These phosphates have recently been studied by Mr. Charles Depéret, who has communicated his results to the Academy of Sciences of Paris.

Geology in France.

The University of France appears to have dismissed geology from its course of higher studies with some abruptness, although it is true that the science is suffered to remain in the fourth class of secondary instruction. This action has caused a vigorous and well-merited protest to be issued by the Geological Society of France. Obviously, it is ridiculous that a science which is, as it were, a summary of all the others, should be taught to beginners and prohibited to advanced students. To put the question on the lowest grounds, it would be a sad day for any country when so eminently practical a science were thrust into the hands of those who can have only a rule-of-thumb knowledge of it. This science has over and over again shown the enormous value of a thoroughly philosophical training to all who would utilise their knowledge for their own or for the public good. We venture to give our hearty support to the French Geological Society, and to hope that its protest may be speedily effectual.

Madagascar Fossils.

The February part of the *Quarterly Journal of the Geological Society* contains a valuable paper by Mr. R. B. Newton, "On a Collection of Fossils from Madagascar," which should interest readers of the article on Madagascar in Natural Science for September, 1893. The chief interest of Mr. Newton's paper lies in the careful and detailed account of previous work on Malagasy geology, which, with its abundant references, cannot fail to be of considerable service to all interested in the faunal riches of Madagascar. The specimens described were collected by the Rev. R. Baron from the Tertiary and Secondary formations in the north and north-west of the island. The figures accompanying the paper show that the specimens are not so perfect as might be wished, and it is to be hoped that future collectors will discriminate when sending home such heavy material. This imperfection is specially unfortunate in the case of the dinosaurian remains sent to England by Mr. Last, and more recently described by Mr. Lydekker before the Geological Society. The remains give evidence of most interesting animals, but are so insufficiently preserved that little can be done with them. More careful search would, no doubt, reveal further materials.

When is a Ruby not a Ruby?

It is recorded that a police constable on duty in a public museum was once overheard making zealous reply to a visitor of an enquiring turn of mind, who had asked the meaning of the word corundum, conspicuous upon a case of minerals; "Oh, that be the place where they put all them stones as they can't guess at." Though inaccurate as an indication of the habits of museum curators, this definition might well refer to the riddle relating to this very mineral which museum curators and others will, unless we are greatly mistaken, be soon called upon to rede.

The artificial rubies made in Paris a few years ago by Messrs. Frémy and Feil were regarded as scientific curiosities. But stones are now being largely sold (it would be very interesting to know how largely) in London and elsewhere which, while closely resembling in all essential respects the rubies of Burma, are undoubtedly of artificial origin. Tried for hardness, specific gravity, lustre, and subjected to all the tests which are usually applied to precious stones, they cannot be distinguished from the natural ruby; this is not surprising, for they are not, like other artificial stones, different from what they profess to be, but are actually crystallised red alumina, only differing from the natural ruby in the process by which they have been produced. Examined with the microscope they betray their origin by the glassy enclosures which they contain and sometimes by a streaky appearance.

Yet it would be difficult to assert that these are not rubies, unless, indeed, the definition of a ruby be understood to include of necessity a natural origin. Considering, however, the enormous prices paid for Burmese rubies, it is certainly not fair that mere imitations should pass as such. If their beauty as jewels be equal to that of the true ruby, let them by all means fetch as high a price as they deserve on their own merits; but we cannot refrain from speculating as to their market value if they were labelled "Made in Paris." According to French law it has been decided, we believe, that a ruby is certainly not a ruby when it is made in a crucible.

Oranges and Frost from Florida.

Walt Whitman brings forward as a proof of civilisation—

> "A bunch of orange buds by mail from Florida.
> To my plain Northern hut, in outside clouds and snow,
> Brought safely for a thousand miles o'er land and tide."

For us the Florida oranges are a similar proof of the smallness of our modern world, with its civilisations made interdependent through commerce, just as its natural phenomena are proved already inter-dependent by science. A few weeks ago the wholesale price of Florida oranges was some ten shillings a box, but now the price is twice or three times that amount. A cold wave passed through

Florida in the last days of December; frost appeared, an unwonted and unwelcome visitor. The fruits on the trees were frozen, next season's buds were blasted, and many a young orchard was destroyed. Hence the higher price of oranges, and the diversion of the trade to our own sunny South. But even thither, as the *Revue Rose* tells us, this cold wave shortly after found its way, damaging the bananas and the early vegetables of Algeria. Lastly it came to us, and consoled the populace for their lack of oranges, by an abundance of skating.

Flora of Borneo.

Dr. Stapf's exhaustive paper on the Flora of Mt. Kinabalu in North Borneo occupies part 2 of vol. iv. of the Linnean Society's *Transactions*. It is based chiefly on plants collected by Dr. G. D. Haviland in 1892, but the author has also made use of material obtained by Sir Hugh Low more than forty years ago, as well as some more recently acquired by Mr. F. W. Burbidge, who went in search of treasures of horticultural interest for Messrs. Veitch, of Chelsea. The paper includes an interesting account, supplied by Dr. Haviland himself, of his ascent of the mountain, in weather unusually wet even for Kinabalu. The southern spur of the mountain forms, like many Bornean heights, a knife-like ridge a few feet broad at the top. "Along this is a track, probably kept open by deer, on either side of which grow plants. These are almost always in flower, and love the sunshine, which can be here felt even through the mist. Among these plants are notably *Vaccinium*, *Rhododendron*, and sometimes Pitcher-plants. A few feet lower down the vegetation is completely changed." "The sides shelved steeply down, and on them grew the sub-summit shrubs with lanky, bent, and angled stems, densely clothed with long damp moss and lichen, and growing *from* the slope rather than *upwards* in the struggle for the light." This zone was more than 100 feet in height; below it came common jungle of mixed trees, shrubs, and herbs. There were no monkeys, and the birds and squirrels were different from the low-country types. At about 11,000 feet quite a different region was reached at the foot of the granite cap which crowns the whole. "Here were patches of shrubs in flower, patches of bare rock, and patches of mossy swamps, where grew buttercups, potentillas, and a small white gentian." The plants on the top itself "were stunted, only a few inches high, growing only in the crevices of the rock, to which they had a very firm hold, so that it was difficult even with both hands to collect them with their roots." In two hollows shrubs were growing; in one, the blood-red rhododendron, in the other, *Rubus Lowii*.

Dr. Stapf distinguishes four zones of altitude. The first, the Hill Zone, from the foot of the mountain up to 3,000 feet, almost entirely occupied by cultivated land and young jungle, or secondary forest, which springs up rapidly on abandoned clearings. This secondary forest is essentially evergreen, with all the characteristics of a true tropical

forest. Here are found palms of the genera *Areca*, *Pinanga*, and *Calamus*, while bamboos play also a prominent part, rising in immense feathery clumps to 50 or 60 feet on the river. In the cultivated land the most important crops are kladi (*Caladium esculentum*) and rice; then sweet potatoes, yams, bananas, tobacco, gourds, melons, cucumbers, and chillies.

Next comes the Lower Mountain Zone (3,000-6,000 feet), occupied, with occasional interruptions or modifications, by old jungle or primary evergreen forest, described as abounding in fine, tall trees, creepers, and epiphytes, commonly also in undershrubs, while the ground is carpeted with ferns and mosses, which increase in quantity and luxuriance with the elevation. A few slender, graceful palms are also to be seen. Bamboos are again a characteristic feature, growing in thick clumps beneath the trees, or skirting open places, or scrambling and creeping and smothering everything. Among the herbaceous plants may be mentioned a violet.

This is followed by the Upper Mountain Zone (6,000-10,500 feet), in which two formations are recognisable from the specimens, namely, primary evergreen dwarf forest and bogs. The forest consists of small trees and tall shrubs from 10 to 20 feet high, sometimes well separated, sometimes forming almost impenetrable thickets. The trees are stunted, twisted, and weather-beaten, with trunks and branches clothed inches deep with dripping moss and festooned with long, beard-like lichens. Only conifers form fine trees in some more favourable places. There is a marked tendency among some of the species to grow gregariously. The foliage is often crowded on short, thick branches; the leaves, which are stalkless or with short, stout petioles, are very coriaceous, dark green in colour, smooth, and glossy. Oval and round forms are frequent. The shrubs blossom nearly all the year round, many of them very freely. No less than nine rhododendrons adorn the ridge with brilliant flowers in clusters or scattered among the dark foliage. Among the climbers, the wonderful pitcher plants are by far the most peculiar feature; at least five species occur here, some climbing in the trees, others scrambling over shrubs or straggling on the ground. Here, too, the ferns attain their most luxuriant development. Two tree ferns are represented, one—a new *Cyathea*—was found at 10,500 feet. The bogs are confined to a few spots, where grow a *Drosera*, a *Utricularia*, some sedges, a dwarf gentian, and some interesting plants of Australian affinity.

Of the Summit Zone (10,500-13,698 feet), the greater part is occupied by bare rock. The forest, dwarfed to a mere shrubbery, ascends to 12,000 feet, while on a flatter area, where many little streams collect and unite before beginning their rapid descent, boggy patches occur, with buttercups, potentillas, and gentians. Here and there a scanty vegetation clings to the rocks.

Dr. Stapf discusses at some length the affinities of the flora of the different zones; among the most interesting is the Australasian,

indicated by such plants as a *Patersonia*, two species of *Coprosma*, a species of *Pratia*, and others.

THE TROUBLES OF A MISSIONARY.

As everyone knows, scientific people, from Darwin down to the merest collectors of bugs, have been indebted in many ways to missionaries; for these go to the uttermost parts of the earth, see much of the natives, and have opportunities for collecting, of which they have availed themselves to the great benefit of science. But there is another side to the question. We have received from a correspondent the following extract from the letter of a missionary:—

"Whether it is due to the Board Schools, or to the improvement in the mail service all over the world during recent years, I think modern missionaries ought to be deeply pitied for the great amount of time and patience they have to expend in writing answers to letters which the old missionaries could never have been bothered with. People write from all parts to say they sympathise with us—will we give them an account of the country in which we live. They write to say they pray for us—will we write and tell them what we are doing. They write and say they are interested in moss, ferns, orchids, beetles, snakes—will we collect, preserve, and bottle a few specimens, and in this way further the interests of Science. It takes three minutes to write questions that it would take a day to answer. I think of filing all such letters for the future, and getting a few forms printed off which will serve all purposes. Something after this style:—'I beg to acknowledge with $\left\{\begin{matrix}\text{thanks}\\ \text{gratitude}\end{matrix}\right\}$ your letter of ———, assuring you that I value your $\left\{\begin{matrix}\text{sympathy}\\ \text{prayers}\\ \text{requests}\\ \text{interest}\end{matrix}\right\}$, and that the subject you mention shall receive my careful attention when I find time hanging heavily on my hands.'"

We trust that our correspondent's friend will not carry out his intention; but scientific people would do well to be considerate in their requests.

TRINOMIAL NOMENCLATURE.

WE are glad to print "O. T." 's letter on this subject, as it gives us an opportunity of explaining our views with more clearness than we seem to have hitherto attained. "O. T.," we must first point out, writes as a zoologist, while our note dealt with the matter professedly from the standpoint of the botanist. The trinomial system, as "O. T." clearly explains, is that "under which races, especially *geographical* races, thought to be of less than specific rank, receive distinctive Latin names in addition to their specific ones." Since the system is applicable only to such races, and not to aberrations, individual variations, and such like, it is clearly immaterial whether "subsp." is or is not inserted between the second and third terms of the series. The term "races," then, is, in the mind of "O. T.," synonymous with the term "subspecies." This is all very well, and

upon certain conditions the system is acceptable enough. The conditions are, first, that the races in question shall be sufficiently definite to be worthy of a Latin name; secondly, that the relation of the subspecies to the species shall be of approximately the same character as the relation of the species to the genus; and finally, that usage shall be invariable and consistent. If zoologists find their discussions facilitated by such a system, and if they will conform to these conditions, we shall not say them nay.

The whole point of the protests that we have raised against certain botanists lies in the fact that these writers, while outwardly employing a trinomial system, have violated its first principles. Let us see how our critic's dicta work out with plant names. Anyone who knows anything about the latter, knows that the usual term for indicating a rank less than that of the species is "var.," but unfortunately "subsp." is used often enough to make it uncertain what term we are to supply when no indication is given. Take, for instance, the first volume of De Candolle's *Monographiæ Phanerogamarum*, the volume containing the names to which we called attention. The book includes three large and important natural orders, elaborated by three well-known botanists all of the first rank. In the first—Smilaceæ—by Alphonse De Candolle, subspecies are frequently admitted; but in the second and third—Restiaceæ, by Dr. Masters, and Meliaceæ, by C. De Candolle—only varieties are found. A repetition of the examples quoted in our former note will show the utter want of comparison between the unmistakable binomial and the very doubtful trinomial. *Smilax Bona-nox Wrightii* stands for *Smilax Bona-nox*, subsp. *Wrightii; S. Bona-nox senticosa* stands for *S. Bona-nox*, subsp. *polyodonta*, var. *senticosa; S. invenusta armata* stands for *S. invenusta*, var. *armata*. So that, on "O. T." 's definition of trinomialism, we are right once in three times, and this is a high average. If we admit *Smilax Bona-nox Wrightii*, why not *Smilax Bona-nox polyodonta senticosa*, and so on? Should we then be any better off than under a pre-Linnæan system, in which the few words by which a plant was known did at least convey some information about it?

Esoteric Science.

Max Nordau, in his well-known work on Degeneration (an English translation of which is on the eve of publication, and which may be expected to become the sensation of the dinner-tables of this season), extends the method of Lombroso to a discussion of most of the prominent writers, musicians, playwrights, and poets of contemporary Europe. We hope to give our readers a detailed account of his book next month. Among the many symptoms of degeneracy that he diagnoses in modern work is a fondness for esoteric terms, for involving a plain idea in an intricate word. Signs of this tendency occasionally are apparent in our own pages; unfortunately they are

too familiar in scientific writing generally. We are well aware that frequently the invention of new words is a necessity and a gain; if a new idea has to be expressed, exactness and conciseness may be found only by neology. But what we must insist upon is that the necessity is always a misfortune, and that the neologist, instead of claiming gratitude, should be a suppliant for pardon and should present the fullest excuse. Last month we put the American "letusimulation" in the pillory; this month the English "isocleronomic" and "anisocleronomic" must succeed it.

In his treatise on the germ-plasm, Professor Weismann expanded an idea that he had previously suggested. It is the idea that two kinds of cell-division exist. In the one case the tendencies and characters of the daughter-cells are exactly alike. Each has received an equal legacy from the parent, and, the legacy being supposed to differ only quantitatively and not qualitatively from the stock of characters that were halved, when the daughter-cells grow up to full stature each becomes an exact replica of the parent. In the other case (the existence of which is not admitted by Weismann's critics), the legacy received by the two daughter-cells differs qualitatively, the characters and tendencies of the parent are distributed unequally between the daughters, and, when these grow up, each is unlike the other and the parent. These two kinds of division Weismann designated as "erbgleich," "equal-heired," and "erbungleich," "unequal-heired"; but, throwing a sop to esoteric terminology, he called them also "Homœokinesis" and "Heterokinesis." Professor Hertwig wrote a treatise (of which a full account was given by Mr. Chalmers Mitchell in NATURAL SCIENCE for August, September, and October, 1894) largely devoted to disproving Professor Weismann's hypothesis of the existence of unequal-heired division. Mr. G. C. Bourne, writing in *Nature* last month a criticism of Professor Hertwig's criticism of Weismann, and agreeing that the existence of the two kinds of division has not been established, invents the new names for them *isocleronomic* and *anisocleronomic*, overlooking, first, that we might have the fact before the name; secondly, that the German name and its English equivalents are ample; thirdly, that if Greek be necessary the original inventor has already suggested Greek names.

I.

The Mammals of the Malay Peninsula.

Part III.

UNGULATA:—As might be expected, the larger Ungulates are absent from so small an island as Singapore; but Deer (*Cervus equinus*), Wild Pig (*Sus cristatus*), and the small Mouse-deer (*Tragulus*) still occur, the latter being abundant. In the Peninsula are also the Elephant, Rhinoceros (one or two species), Tapir, Wild Ox (one or two species), the Kijang (*Cervulus muntjac*), and the Wild Goat (*Nemorhædus sumatranus*).

The Wild Pig (*Sus cristatus*), or "Babi Hutan," is far too abundant. It is most destructive to the pineapple- and tapioca-fields. Coming out of the woods at night and falling on the crops, it contrives to do a great deal of damage in a very short time. It is not entirely nocturnal, for one may often see it moving about in the day-time, and I have seen boars feeding among the buffaloes in the swamps at midday. The young are spotted with yellow, like the young of the tapir.

The habits of the Rhinoceros here are but little known, and it is by no means certain how many species there are. The Malays call it "Badak," and they also talk of a beast by name "Badak Api" (*lit.*, fire-rhinoceros). From the only native I ever met who could tell me about the latter animal, I gathered it had a red appearance, and guess it to be perhaps *R. sumatrensis*. The animal is not often seen, and I never heard of one being trapped. Europeans sometimes shoot them, but never take the trouble to bring any specimens home, so that it is really difficult to decide what species we really have. The common one appears to be *R. sondaicus*. It frequents the hill-jungles, ascending to 4,000 feet altitude, and seems usually to move about at night, though one may come upon it by day. It has a habit of constantly using the same track, and dropping its dung in the same place daily, a habit common also to the tapir. As the jungle gets cleared, it wanders often into the low, open country, apparently losing its way. It is a quiet, inoffensive beast.

The Tapir (*Tapirus malayanus*) is called "Tenok" by the Malays; the name "Kudah ayer" (water-horse) given as a Malay name in some Natural History books is not known to any native I have ever met, and appears to be entirely fictitious. This animal is still tolerably

abundant in the further jungles of the interior, and though rarer than the rhinoceros, is oftener to be seen in captivity. It is wonderful how so defenceless an animal should be able to escape the attacks of the bigger carnivora; but it inhabits the deeper hill-woods where the tiger is scarce or does not go, and is very quick at hearing and slipping away from an enemy. It eats grass, and more usually bushes. A tame one was found to prefer the common *Melastoma polyanthum* to any other plant. It also ate fruit and boiled rice, and was very fond of biting and eating bones.

The young one is dark brown, with yellow, creamy spots, a most beautiful adaptation for protection; as it lies during the hot part of the day under the bushes, its coat is so exactly like a patch of ground flecked with sunlight that it is quite invisible. Some of the spots are round and some are elongate, the former resembling the flecks of sunlight falling vertically, the latter those which come slanting through the foliage. The little animal lies in such an attitude that the round and long spots are exactly in the position in which the sun-spots would be. On one occasion my tapir was lying asleep during the hot part of the day among some bushes, and wishing to shut it up, I went to look for it; but on parting the bushes I could not see it at all, though I was absolutely looking down upon it. In the jungle any animal of a single colour is much more conspicuous than a parti-coloured one, the mass of colour striking the eye more clearly. So that an entirely black or entirely white animal is easily seen; but a mixture of the two colours blends with the reflections of light and shadow falling on the ground through the foliage. The adult tapir is black, except for the tips of its ears and from the saddle to the rump, which parts are greyish-white; this would be thought conspicuous enough at first, but it is not at all so. When lying down during the day, it exactly resembles a grey boulder, and as it often lives near the rocky streams of the hill-jungles, it is really nearly as invisible then as it was when it was speckled. It feeds at dawn, and till the sun gets hot, when it retires to sleep, recommencing at dusk.

The tapir when young utters a kind of whistle, which can be heard afar; it is done through the trunk. The adult gives a kind of low coughing bark, as an alarm-note. As in its haunts it has often many obstacles, such as fallen trees and rocks, to scramble over, it is quite skilful at clambering about, and when as big as a fair-sized pig my animal would contrive, if left alone, to get upon a chair and thence upon the table. It can trot, or gallop at a good pace, and goes very fast through the jungle when disturbed. When taken young it becomes very tame and amusing. As the jungles are cleared the tapir becomes rarer and rarer, but it is to be hoped that it may be long ere this most interesting element in our fauna becomes extinct.

On the Elephant it is hardly necessary to give any notes. It is not excessively abundant, but is plentiful in many parts of the Peninsula. It is called "Gajah" by the Malays, who seem rather

to dread it. The Aborigines, known as Sakais, sometimes hunt it. There was recently living a man who used to follow up a herd and, selecting an animal with good tusks, creep quietly up; when near enough he would drive a large-bladed spear between the hind legs into the abdomen, which wound was soon after fatal, and tracking the animal, he would secure the ivory.

The black Wild Goat (*Nemorhædus sumatranus*) inhabits the isolated patches of limestone rocks which flank at intervals the main granite chain of the Peninsula. Though apparently not rare in these places, it has never been shot by any sportsman, and the only specimens I have seen are skeletons and a head in the Perak Museum.

The natives often affirm that there are two distinct species of Wild Ox in the Peninsula, viz., the Sāpi and the Sĕladang; but I have never been able to find out what the former is. It is stated to be quite a different animal, with longer horns than the Sĕladang (*Bos gaurus*). The latter is probably the biggest and most powerful ox now living, though even it is inferior in size to the old British ox, *B. primigenius*. The Sĕladang usually inhabits the denser hill-jungles, where its tracks may often be seen; but it is also abundant in more open, grassy spots, such as the banks of the Pahang river. It lives chiefly on leaves of trees, but also eats fruit.

There are two or three species of Mouse-deer in the Peninsula, of which the commonest is the Napu (*Tragulus napu*). It is as big as a hare, and generally inhabits the thicker woods. It can swim well, and I have seen it crossing a small stream, swimming very low in the water. The call is a low bark, like that of a fallow-deer, though by no means as loud; but they often call to each other by beating their feet upon the ground. This is taken advantage of by the natives in shooting them, in the following way. A hunter, placing a dry leaf on the ground in the wood where mouse-deer are supposed to be, taps it with a stick, thus—Tap: tap-tap-tap: Tap: tap-tap-tap: Tap, now and then making a rapid succession of taps like the roll of a drum. Presently the Napu answers by stamping its feet in the same manner, and the tapping is continued. The animal comes nearer and nearer, answering as it comes, till it comes within range of the gun. Sometimes, it is said, a tiger, thinking that the tapping is really that of a Mouse-deer, comes up instead. The Napu is also caught by springes. A small palisade of sticks about a foot high is made across a wood, and at intervals passages are made in the wall big enough to admit the animal. In these is set the springe, made by bending down a small slender shrub, with a noose held in position by a small stick, and the noose is covered by a leaf. The Mouse-deer, on meeting with the palisade, does not jump over it, as it could easily do, being very active at leaping, but goes along it till it can find a passage through, and putting its foot in the noose is immediately caught. It is sold in the markets for food.

In captivity the Mouse-deer require plenty of room to run about

or they will stay perfectly still in one corner till the hind legs become callused at the joints, and even paralysed. They become very tame, but sometimes fight together, biting each other's ears and noses. The males can also give sharp cuts with their long, sharp canine teeth. They eat sliced sweet potatoes, and almost any green vegetable. Sometimes they do a good deal of damage to garden crops, and are rather troublesome.

The Napu varies somewhat in colour, and I have had some specimens which were remarkably bright chestnut on the back. These came, I was told, from Rhio, south of Singapore. They appeared so distinct in colouring that it is possible that they may belong to a distinct species.

The Kanchil (*Tragulus kanchil*) is a much smaller, perfectly brown animal. It is supposed to be very cunning and plays the part of Brer Rabbit in Malay folklore, but I never saw anything in its behaviour to justify its reputation. The natives state that there is a third species which is called Pelandok, intermediate in size between the two; but the name is also used vaguely for either species, and if there is a third species here, I have either not seen it or failed to distinguish it.

The Napu breeds in confinement, producing one or two at a birth. It appears to have a long period of gestation, for one that had been for some months in an enclosure without a male unexpectedly produced a young one.

The Kijang (*Cervulus muntjac*) does not occur now in Singapore, if it ever did. It is abundant in many places, such as the slopes of Mount Ophir, and is often shot by planters and others in and about the coffee plantations. Very little is known of its habits.

The Rusa (*Cervus equinus*) is common in the Peninsula, and a few still occur in Singapore; but most have been killed by sportsmen. It inhabits the open country and small woods. I have, however, seen the tracks of a big deer quite at the top of Mount Ophir, at 4,000 ft. elevation. As the animal seems to avoid paths when possible, it is comparatively rare to find its tracks, while those of tiger, pig, mouse-deer, ox, tapir, rhinoceros, and elephant are all conspicuous whenever one is in the district where they abound. It feeds at dusk and dawn, remaining quietly in the woods during the day. It is often kept in captivity, and sometimes breeds; but the buck is rarely safe in the rutting season, and sometimes becomes then most dangerous. A fine example in the Botanic Gardens, though brought up from a fawn, on one occasion attacked the coolie who was giving it water, and tossed him over the palisade of its enclosure, inflicting severe wounds on him, and later succeeded in forcing its way into an adjoining paddock, where a black buck was kept, which it killed by one thrust of its antler. The young are produced singly, and are coloured like the adult, but with much softer hair. There are, however, faint traces of light spots on the rump, which disappear after the first week.

The natives say that there are two species of deer—the Rusa Daun (foliage deer) or Rusa Hijau (green deer), and the Rusa Lalang (grass deer), the former residing in the forests, the latter in open grassy country. They are said to differ in colour, and are probably merely local varieties.

Sirenia :—The Dugong (*Halicore dugong*) is tolerably common in the strait between Johore and Singapore; but one does not often see it. However, the Chinese sometimes catch it in nets when fishing, and sell it in the markets as food. It is said to live on the marine phanerogam Setul (*Enhalus acoroides*), but very little is known about it. I have seen it sleeping on the surface of the sea, when it looked like an old brown trunk of a coco-nut tree floating about. It is called "Duyong" by the Malays. It is remarkable that an animal so defenceless and slow should be able to hold its own against the sharks and crocodiles which abound in its haunts.

Edentata:—Our only representative of this Order is the common *Manis javanica*, the Tengiling of the Malays. It is frequently found in open sandy country making large burrows in the ground. Termites form its principal food, but ants are also acceptable to it. From the difficulty of feeding it, it is impossible to keep it long in captivity; but it is often brought for sale, and I have had a female with a young one for some days. In spite of its appearance it can climb trees well, but slowly, using its prehensile tail to aid it, and one would remain for a long time suspended by its tail to a bough, its head curled in between its paws. The Chinese are fond of eating this animal, but the flesh is tough and not worth eating.

These notes are naturally very incomplete as an account of our mammal fauna, but they may call attention to many points which require settling, and which it is to be hoped intelligent and observing explorers will in time work out. It is only by watching the animals in their native haunts that it is possible to realise the meaning of their special colouring. Much depends on their habits: an animal which is much exposed by day is naturally differently coloured from one which, well concealed by day, exposes itself in the dusk. Animals which change their habits as they develop often change their colouring to suit their environment. The young of the tapir, pig, and kijang illustrate this, lying hid during the day beneath the foliage, where their speckled coats match with the sun-flecked ground. Their parents are weak beasts which are unable to protect them from attacks of enemies, and their only hope of escape is in remaining motionless, so as to be overlooked. When strong enough to seek safety, like their parents, in flight, they adopt the adult colouring. The adult tapir, as has been said, resembles a grey rock. The pig is of the colour of the dark mud of the forests in which it spends the day; but not being quite black, appears at a short distance of a dusky grey in the evening twilight, when it usually leaves the

forests to feed in the open country. The russet brown of the kijang, flying squirrel, and the wild dog appears at first sight most conspicuous, but somehow it is not as visible as one would think. This brown-red colour, so common in wild dogs, such as the dingo, is very often to be seen in pariah dogs, *i.e.*, the offspring of domestic dogs which have taken to a jungle life, and I have noticed that these brown ones are much more difficult to see in the dusk than those of any other colour. The invisibility of the tiger when moving quietly through the long grass and fern, or when waiting in ambush for its prey, has been mentioned by others. About our only other striped animal, *Hemigale hardwickii*, little is known. It may be diurnal in habit. The only person whom I have met with who has seen one wild is Mr. H. L. Kelsal, who saw one under a log in thick jungle by the Tahan river in Pahang. It may, perhaps, conceal itself usually among the grasses by the river edge, where it would be very inconspicuous. Of really black animals we have the bear, black panther, *Hylobates*, and some *Semnopitheci* and *Sciurus bicolor*. The first of these not being carnivorous, and, at the same time, being a match for almost any enemy, has no necessity to conceal itself. The black panther is quite nocturnal, and being a powerful beast has no need for special colouring to conceal it during the day. *Hylobates*, *Semnopithecus*, and *Sciurus bicolor*, all strictly diurnal in habits, seem free from any enemies, living high up in the trees, where carnivorous animals never go. The monkeys do not attempt to conceal themselves, but, on the sight of an enemy, dash off with immense leaps, often uttering warning cries. The squirrel, which is slower in habits, usually hides itself among the thick creepers in the nearest tree which it can find when alarmed. It is interesting to note that in both *Hylobates* and the squirrel we have forms of the equally or more conspicuous colour—white, a colour very rare among mammals, and there are also white species of *Semnopithecus*. The smaller monkeys, on the other hand, which often come down on the ground and are liable to attacks from wild cats and other carnivora, are grey or brownish and far less conspicuous, though the young of the Kra are born with black hair, which is replaced by grey as soon as they can go alone.

The colouring of mammals is, then, in this region adapted for concealment. There is no instance of modification for signalling to each other, either by warning colours or by attracting colours, like the white tail of the rabbit. Indeed, such would be absolutely useless in a jungle country, where animals at a few yards' distance from each other could not see each other. Warning and attraction are both effected by the voice, and the latter probably also to a large extent by scent. Still, even in jungles, where, from the fresh tracks, one can see that big animals are abundant, one may remain for days without hearing more than the morning wail of the Wa Wa, the loud cry of the Lotong, and occasionally the distant bark of a tiger.

H. N. RIDLEY.

II.

The Development of Spiders' Lungs.

I REGRET that, when compiling my "Further Notes upon the Organs of Arachnids" (NATURAL SCIENCE, vol. v., pp. 361–5), I overlooked an important recent memoir by M. Jaworowski, describing the development of the breathing-organs in the large hunting-spider, *Trochosa signoriensis* (*Zeitschr. für Wiss. Zool.*, vol. lviii., 1894, pp. 54–78, plate iii.); especially as the results obtained by this author seem to contradict those of Mr. O. L. Simmons, whose work, as I mentioned, supplied evidence for that view of the relationships of arachnid lungs to tracheal tubes which I myself am disposed to accept. It will be remembered that, according to Mr. Simmons' researches, the lung-plates of spiders arise on the hinder surface of abdominal limbs (comparable to the gill-bearing appendages of *Limulus*) which sink into the abdomen as development proceeds. The tracheal tubes are said to show at an early stage traces of pulmonary plates which afterwards vanish. This, by itself, seems conclusive evidence that external gills preceded lung-books, and that lung-books are more primitive than tracheæ. It is only right that the attention of the readers of NATURAL SCIENCE should be called to M. Jaworowski's paper, which seems to favour the opposite view.

In the early stages of the development of the lung-books of *Trochosa*, according to this observer, a tube runs dorsal-wards from the in-pushing behind the abdominal appendage. This tube ramifies into several branches, forming an embryonic tracheal system. As the lung-book is developed, by the folding of the wall of the invagination, the tubes degenerate, the process beginning with the smaller branches; and, as growth proceeds, they disappear altogether. The existence of similar vestigial tracheæ has already been pointed out by Professor Schimkewitsch in the embryo of *Lycosa* (*Arch. de Biol.*, vol. vi., 1887).

From these considerations, M. Jaworowski concludes that among the arachnids tracheal tubes must certainly have preceded lung-books. He admits, however, the arachnid affinities of *Limulus*, and the homology of the external gill-bearing limbs on the abdomen of that animal with the lung-books, sunk within the abdomen, of a scorpion or a spider. His conclusion, therefore, is in accordance with the view of Dr. Simroth, as expressed in his book "Die Entstehung

der Landtiere" (Leipzig, 1891), namely, that *Limulus* has been derived from tracheate ancestors, living on the land. He further brings forward reasons for supposing a similar origin for the Crustaceans.

I need not again dwell at length upon the morphological and palæontological facts which seem to forbid us to accept this theory. The comparative study of living forms shows that the scorpions and scorpion-spiders (Pedipalpi), which breathe by lung-books only, are more primitive than the spiders; and that those spiders which breathe by lung-books only are lower in the scale than those in which the hinder pair of lung-books are replaced by tracheal tubes. These conclusions are confirmed by the study of fossil forms. In phylogenetic speculations, due weight must be accorded to evidence from all quarters; and, while M. Jaworowski's researches deserve careful consideration, the embryological fact which they establish need not lead to the abandonment of the position required by the comparative study of living and fossil arachnids. The admission of the correspondence between the gill of *Limulus* and the lung of the spider leaves us free to accept Mr. Simmons' interpretation of his observations, if some reasonable explanation can be found for the evanescent tracheal tubes which M. Jaworowski describes. It seems possible that, in the passage from an aquatic to a terrestrial life, before the gill-bearing limbs became converted into lung-books, air tubes in connection with these limbs would have been of great service to the primitive arachnids. Such a stage is somewhat similar to what we find at present in the land-isopods. As the limbs sank into the abdomen, and the plates became adapted for breathing air, the necessity for the tubes would pass away, and they would, in course of time, become lost. Their appearance in the embryonic stage of certain spiders is what might be expected upon such a hypothesis.

Geo. H. Carpenter.

III.

The Origin of Species among Flat-Fishes.

THE purpose of this paper is to consider how far, by the help of the various principles which have been suggested or advocated, we can obtain a satisfactory explanation of the evolution of the family of flat-fishes. We may assume that descent with modification is the process of organic evolution. But the question is, how far we can really explain the modification, and especially how we can explain the peculiarities of its results, the relations of structure which form the subject-matter of taxonomy, the relations between the characters which divide organisms into species, genera, families, etc. Thus, by the evolution of flat-fishes I mean, not what is usually meant—how they came to lie on the bottom on one side and have both eyes on the upper side; but how and why they diverged into a multitude of distinct species arranged in a number of genera, which form higher groups called sub-families. This method of studying the problem of evolution, namely, by examining all the problems presented by the morphological relationships of a particular kinship, from the family down to the individuals, or from the individuals to the variety, from varieties to species, species to genera, etc., has very seldom, if ever, been followed.

Zoologists may be divided into three classes:—(1) The investigators of evolution who, with Darwin as their pattern, follow the inductive method, and having arrived at some general principle give a general survey of the biological facts which support it. (2) The embryologists and comparative anatomists, who investigate and describe morphological facts and structural phenomena, and trace homologies: their work consists almost entirely in investigating the results of descent with modification, and its historical course; they have little concern with the origin of modifications, though they usually assume one theory or another. (3) The systematists and naturalists, who investigate the minutiæ of structure and habit which characterise the different kinds of organisms, from main divisions down to the smallest distinctions by which a variety or race can be recognised: these as a rule do not trouble themselves about evolution at all; their method is simply empirical. We may roughly characterise the three classes as the followers of Darwin, the followers of Cuvier, and the followers of Linnæus. The theorists of the first class are too apt to

take illustrative facts from various provinces of the animal kingdom without reflecting that these facts may be all of one class, and that there may be facts of quite a different class which they ignore. The question whether the principles of the theorists are in harmony with the details of the empiricists has yet to be thoroughly examined.

The most recent important contribution to the study of evolution in this country is Bateson's "Materials for the Study of Variation, treated with especial regard to Discontinuity in the Origin of Species." In this work, as in its predecessors, the method is to search the animal kingdom for instances of one class of facts, instead of taking a portion of the animal kingdom and ascertaining how many classes of facts it presents. Valuable as the work is, and important as are the aspects of variation to which the author draws attention, one cannot help being astonished at the fact that Mr. Bateson writes as though, apart from adaptation to the environment, no explanation of the discontinuity of specific forms had been offered before he himself took up the problem. He does not mention that, so long ago as 1886, Romanes maintained that Natural Selection was a theory of the origin of adaptations, by no means a theory of the origin of species; or that two years later Gulick published most important evidence of the origin of varieties by mere divergent variation through isolation, without any adaptation at all. In fact the modes in which variations, instead of being individual peculiarities within a species or other taxonomic group, are to become constant and characteristic of a distinct group, are never discussed by Bateson. Except in one or two rare instances, he entirely omits to consider the relation between the variations, whose description makes up the body of his book, and the taxonomic characters of the forms in which they occur. There is some logic in his contention that, since environments are often continuous, their influence cannot always explain the discontinuity of species. But it is clear that, if progressive modification in different directions goes on in two groups of a single species which are isolated so that no interbreeding takes place, then two species will be formed, the discontinuity between which will become greater at every generation. This result will follow, however gradual and continuous may be the modification in each group. Mr. Bateson's argument is defective, therefore, in two respects: first, there is no necessity for discontinuity of variation to explain discontinuity of species; secondly, he has not attempted to show where discontinuity of modification probably did occur historically in the evolution of any particular group.

In reference to the flat-fishes (Pleuronectidæ), Bateson (p. 466) discusses only one class of variations, namely, the partial or complete coloration of the under side, and the abnormality of the head associated with the complete condition. He argues that this kind of variation cannot be explained simply as reversion to an ancestral condition. In this I entirely agree with him. But he does not consider the question how the occurrence of this variation bears upon the specific characters,

or on the origin of the actual differences between existing forms of Pleuronectidæ. Bateson mentions cases of the abnormality in question in six species belonging to three genera. In no case is the variation diagnostic of a distinct race, variety, or species. Bateson argues that it is discontinuous, that is to say, normal parents may produce an individual presenting the abnormality fully developed without intermediate stages. There is every reason to believe that this is true. But supposing this condition were to become constant and peculiar in separate races, what would be the result? The difference between these individuals and normal individuals is a difference not in specific or generic, but in family characters. Supposing the condition became constant and were regularly inherited, we could not even say that we had a new family or sub-family, because the quasi-symmetrical turbot would still be a turbot, the quasi-symmetrical flounder still a flounder, and so on. We should simply have dimorphic species, or species which presented two distinct but parallel forms. If, however, the condition in question became the normal condition, and the condition which is now normal became rare or extinct, then the characters of the family would be changed, and changed by a sudden leap from the one condition to the other. Bateson might suggest that the normal characters of the Pleuronectidæ arose by a sudden change from the symmetrical condition, just as the abnormal individuals at the present time arise without gradation from normal parents. But this would be an untenable supposition. In the individual Pleuronectid at the present day the family characters arise by a gradual change in development; and we should have to believe that this change took place in certain individuals completely the first time it occurred. But the occasional variation we have been considering is probably due, as suggested by Bateson and myself, to the occasional manifestation in the organism of a tendency to symmetry, in virtue of which the characters of one side are reproduced in the other. This phenomenon, which Bateson calls homœosis, is exhibited in asymmetrical animals, where the two sides are normally different. But we have no evidence of any converse tendency, of a general tendency to asymmetry, by virtue of which one side may be entirely different from the other. We have therefore no facts which suggest the probability that the first flat-fish arose directly, without any intermediate steps, from parents whose two sides were quite similar. Here, for the present, we may leave the discussion of these abnormalities, merely recurring to the main point insisted upon, that they affect, not specific or generic characters, but family characters, and, moreover, family characters which are adaptive.

Let us turn to the consideration of specific diversity in this family. For the details to be discussed I am largely indebted to a very able paper by David Starr Jordan and David Kopp Goss, entitled "A Review of the Flounders and Soles (Pleuronectidæ) of

America and Europe," published in the Report of the United States Commission of Fish and Fisheries for 1886, although, so far as relates to British species, I can speak from my own observations.

Zeugopterus is a fairly well-marked genus, with a very limited distribution. Its definition is to some extent a matter of opinion, different ichthyologists classifying the species differently. It is, however, agreed that there are three species that all possess the following characters: a large foramen in the septum between the gill-cavities; the posterior extremities of the dorsal and ventral fins prolonged on to the lower right side of the body beneath the base of the tail; the scales on the upper surface ctenoid, having a single row of spines, of which the central one is prolonged; the shape of the body approaching the rectangular. The three species are definitely distinguished from one another by the following single characters: in *Z. unimaculatus*, Risso, the first ray of the dorsal fin is produced into a filament; in *Z. punctatus*, Bloch, the pelvic fins are concresced with the ventral (or anal); in *Z. norvegicus*, Günther, neither of these characters is present.

As to distribution, no species having the foregoing characters has been found anywhere except on the coasts of Europe, and all three species occur on the British coasts. *Z. punctatus* is fairly common near Plymouth, and occurs all along the south and east coasts of England. It has been taken on the east coast of Scotland as far north as the Orkneys, on the west coast in the Firth of Clyde, also on the east coast of Ireland. Northward the species extends to the north coast of Norway, southward to the northern shores of France, but it is absent from the Mediterranean. *Z. norvegicus* is also a northern form absent from the Mediterranean. I have taken several specimens at Plymouth; one specimen has been taken on the west coast of Ireland, and three specimens in the Clyde. It is somewhat rare on the Scandinavian coasts. *Z. unimaculatus*, on the other hand, is a Mediterranean form, only occasionally taken on British and northern coasts. I have never obtained a specimen at Plymouth. On the south-west coast of Scotland it is more abundant than at any other part of the British coast, several specimens having been taken in Loch Fyne and the Firth of Clyde. It has been taken on the coast of Denmark, but not on the coast of Norway.

Steenstrup is the only ichthyologist who has placed these species in the same genus, *Zeugopterus*, and he included with them the whiff or megrim, *Z. megastoma*, because it too has the perforation in the septum of the gill-cavity. The three species have been separated by Günther and others according to the presence or absence of teeth on the vomer, and the union of the pelvic with the ventral fin, or its separation therefrom. But the three species are so similar in their general character, and are united by such salient features, that it is clear they have recently diverged from a common parentage.

We have certain direct observations on the habits of these fishes

which enable us to some extent to form a judgment on the utility of the generic and specific characters respectively. *Z. punctatus* and *Z. unimaculatus* have been watched in the living healthy condition by the late Mr. George Brook and by myself, and both of them found to have the habit of adhering to the sides or glass front of the tank in which the fish were confined. *Z. norvegicus* has not been observed in the living condition. Mr. Brook in his first account of the habit in *Z. unimaculatus* stated that when the fish adhered to the glass front of a tank the body was raised up from the surface, and the outer parts of the fins tightly pressed against the glass. A constant current of water passed out from the branchial chamber on the lower side, between the body and the glass, and out beneath the hinder portion of the longitudinal fins. This current was produced by a "vibratory motion of the accessory portions of these fins." Brook's conclusion was that the accessory portions of the unpaired fins were specially constructed to aid in the respiratory function. In a later paper Brook abandoned this view, stating that the motion of the fins by which the current was produced was more vigorous in the rays immediately in front of the tail than in the accessory flaps situated beneath it. In a specimen of *Z. punctatus* observed by me, the anterior parts of the fins were kept quite still and tightly pressed against the glass. The lower surface of the tail and of the accessory flaps of the fins were also in close contact with the glass. The other parts of the surface of the body were separate from the glass. The motion of the broadest part of the fins anterior to the tail was undulating, and aided to cause the current of water which entered the space between the body and the glass, not only by passing through the mouth and gill-clefts, but also behind the operculum between the lower jaw and the pelvic fins. The question arises, what causes the fish to adhere to the glass? Other flat-fishes adhere to smooth surfaces for a time, but none keep in that position at rest for a long time as the topknots do. Is it simply the adhesiveness of the mucus on the epidermis? Or is it that the pumping action of the posterior fins causes a negative pressure beneath the body, and so there is a slight pressure on the outside of the fish? There is no sucker action of the ordinary kind, because the space beneath the body is freely open in front to the outside water. It was suggested by one of us who were watching the fish that the tail fin and the accessory flaps together formed a small complete sucker by themselves. The accessory parts of the unpaired fins were quite motionless. I cut off these accessory portions with two snips of a pair of scissors and returned the fish to the tank. The fish did not alter its behaviour in the least; it stuck to the glass when placed there as easily as before, and seemed in nowise the worse for the operation. The accessory flaps, therefore, do not appear to be essential either to the respiration of the fish or to its adhesion to a vertical surface.

It seemed difficult to believe that the pumping action of the posterior part of the fins could cause a negative pressure beneath the body, because the respiratory movement was going on while the fish adhered to the vertical surface. This respiratory movement forces a current of water into the space below the body through the lower gill cavity, and this would necessarily produce a positive pressure. However, the currents of water were ascertained by watching the course taken by particles of suspended matter in the water, and afterwards by dropping carmine with a pipette at points in the neighbourhood of the head. The carmine was seen to pass in at the mouth and out at both gill-openings, and no difference was observed in the respiratory currents from those of an ordinary fish. The perforation of the gill-septum was therefore not found to play any special part. But the carmine was also drawn into the space below the body through considerable passages above and below the jaws. This proves that more water is pumped by the action of the posterior parts of the fins than passes through the mouth and gill-openings. This, therefore, must cause a pressure on the outside of the fish against the vertical surface on which it rests. In order to test whether a pressure caused in this way would be sufficient to produce the adhesion, I endeavoured to construct a simple apparatus which would reproduce the conditions observed in the fish. I took a rectangular piece of sheet india-rubber, 6 inches long by 4 inches broad, and at each end of its longer axis I fastened, with needle and cotton, a short piece of glass tube. The tubes did not meet in the middle of the piece of india-rubber. A siphon was placed on the edge of the glass front of a tank, and its end in the tank connected by a long india-rubber tube to one of the tubes on the india-rubber flap. When the flap was placed against the glass with the glass tubes towards the latter, a current of water was drawn from beneath the flap by means of the siphon. The longer edges of the flap became pressed against the glass, while the entering current passed through and at the sides of the glass tube which was not attached to the siphon. In this apparatus the drawing of the siphon represented the pumping action of the fins in the fish, while the piece of glass tube in front represented the mouth and gill-opening of the fish, the water being able to pass at the sides of the tube as it passes at the edges of the jaws and head in the fish. The only differences are that the respiratory movement in the fish is absent in the apparatus, and that the tube representing the mouth communicates only with the space beneath the rubber flap, not with the outer side of the flap also, as in the fish. These differences are unimportant, because it is certain that the respiratory movement in the fish does not cause the adhesion, and there is in the fish a current caused by the pumping action of the fins over and above the ordinary respiratory current. It was found that the flap just described adhered to the vertical surface of the glass front of the tank so long as the siphon was running, and fell off as soon as the flow through the siphon was stopped.

An important specific difference between *Z. punctatus* and *Z. unimaculatus* is the concrescence of the pelvic and ventral fins in the former and not in the latter. Yet the observations on the two species show that this feature has nothing to do with the peculiar habit described. No difference of habit has yet been detected corresponding to this difference of structure. Nor have we yet any evidence of the utility of the prolongation of the first dorsal ray in *Z. unimaculatus.*

But these are not the only specific differences. There are others which consist in differences of the degree to which the generic characters are developed. In other words, the specific characters of the three species form a series. Even the vomerine teeth and the union of the pelvic and ventral fins are to be regarded as terms of such a series, for the teeth on the vomer are, in *Z. norvegicus*, very small, in *Z. unimaculatus* absent, in *Z. punctatus* well developed, while in the former two species the pelvic fins extend backwards so as to embrace the anus and commencement of the anal fin, although they are not united with it. The other characters, for example the accessory finlets and the scales, are developed in different degrees in the three species. The finlets are largest and the rays most branched in *Z. punctatus*, in which each contains six rays, while in *Z. unimaculatus* and *Z. norvegicus* there are not more than four. The generic character of the scales is that the exposed portion is short antero-posteriorly; there is a single row of spines of which the centre one is prolonged and extends directly outward from the surface. In *Z. punctatus* this character is developed to the maximum, the whole exposed portion of the scales being bent nearly at right angles to the embedded portion; the projecting spines are not of one uniform length, but those of maximum length occur at scattered points. It is this character of the scales which gives the peculiar hirsute character to the skin of *Z. punctatus.* It is developed also in *Z. unimaculatus*, but in *Z. norvegicus* occurs to a much less degree. In the last species the exposed portions of the scales are broader and lie flat to the body, but here and there occurs one with a projecting central spine; these are more abundant on the head.

If the generic characters were adapted to peculiar generic habits, the specific differences in these characters might be similarly adapted to differences in the habits. I have given evidence that the accessory flaps of the fins beneath the tail are not necessary to the habit of adhesion, which is produced by the movement of the posterior part of the fins, and this is related to the characteristic shape of the body, which depends on the breadth of the body and fins at the posterior end. This, therefore, might have been selected, but on the other hand the enlargement of the posterior part of the body might have been produced by the movement. Young brill have been seen to move the posterior parts of the fins when adhering to glass. The peculiar character of the scales has, so far as the evidence goes, no

adaptive meaning at all, either in its generic extent or in the specific differences. Nor, as already shown, is there evidence that any advantage is conferred on the fish by the perforation of the gill-septum.

The utmost that can be admitted then as adaptation in these fish is the shape of the body and breadth of the fins behind. The linear extent of the fins is as great and greater in many other genera. The accessory flaps beneath the tail, and the extent of the pelvic fins, cannot be regarded on present evidence as of adaptive meaning; still less can the specific differences.

The relations of these three species, on the view that their differences are not adaptive, illustrate certain principles which have been elaborated by Romanes and Eimer. They exemplify the class of facts which Romanes intended to explain by his theory of physiological selection, which, reduced to its simplest terms, states that species whose geographical ranges overlap or to a large extent coincide, could not become distinct if they were constantly interbreeding. Thus *Z. punctatus* and *Z. norvegicus* occur together in Norway and Britain, but do not interbreed, and *Z. unimaculatus*, though alone in the Mediterranean, lives with the others from Denmark southward. Whether these species are sterile *inter se*, whether fertilisation of one by the other is physiologically impossible, whether their reproductive seasons are such that opportunities for intercrossing do not occur, or whether the intercrossing is prevented by the mating instinct of the individuals, is not at present known, and does not very much matter. The main point is that so long as intercrossing took place, variations that occurred in one group of individuals would sooner or later become the common property of all the members of the parent form; and that when the three groups were kept apart, a variation that arose in one would be confined to that one. We may take it as settled by observation that when groups of a species are isolated they will diverge by variation. It may be asked, why should two groups of individuals, having originally the same habits and spread over the same area, enter upon divergent lines of modification, simply because they are separated? We do not know, but we can safely say that they will do so. We have first to ascertain what does take place before we can find out why it takes place; and when we find that the differences between species are not differences of adaptation to different modes of life, we have simply to study these differences and their history as structural features. It is clear that in artificial breeding, separation of varieties is one of the most important conditions, and there is abundant evidence of the same separation in nature. The term selection often seems to imply this separation, but inasmuch as selection always means principally the preservation of certain individuals in a given variety or race, by human choice in domestication, by the struggle for existence in nature, and therefore always implies a teleological view of structure, therefore it is better to use a distinct term, and the best seems to be "isolation." We may

reasonably hold that the explanation of the similarity of individuals in a species is the constant intercrossing of individuals. In other words, Weismann's condition of panmixia occurs within every homogeneous group, and tends to produce not degeneration, but uniformity. There is no reason why this condition should prevent modification. A species may produce great variations, and these may be gradually extended to all the individuals, so that the later characters of the species may be very different from the original, but unless there is segregation or isolation of one group of individuals from another there will be no divergence, no splitting up of the one species into two or more.

Although the mode in which Eimer has expressed his views on variation is sometimes obscure and involved, there can be no doubt that he has perceived important phenomena which have been more or less neglected by other naturalists. The relations of several of the characters of *Zeugopterus*, the fact, that is, that they differ only in degree of development, form examples of what Eimer calls "genepistasis." But this is not to be considered as implying that, as Eimer believes, the less developed characters represent stages actually passed through in the development of the individuals of the species where these characters are more developed. The development of specific characters is a subject I am investigating, and I have not actually traced the development of those of *Zeugopterus*; but I hold this part of Eimer's view to be exceedingly improbable. It is evident, where the character depends on the number of parts, that, as Bateson points out, the greater number is not usually formed by addition to a smaller number, but by the greater subdivision of the developing blastema when the parts are about to be formed. It seems to me that the facts represented by the term "genepistasis" are simply due to the common descent of closely allied species. The generic characters are either derived from the common ancestral species, or represent the similarity of variation due to the blood-relationship of the species. The specific differences of degree are merely instances of the general fact that the species have varied independently, some developing characters of the ancestral species more strongly, some less, while at the same time variations occur in one species which are not represented at all in the others.

Plymouth. J. T. CUNNINGHAM.

(*To be continued.*)

IV.

Wasps and Weather.

THE last two years have afforded in close proximity diametrically opposite conditions with regard to both weather and abundance of wasps. It may, therefore, be of value to put on record a brief summary of the climatic susceptibility of these insects.

In NATURAL SCIENCE, vol. iii., pp. 273–275, I have already given an account of the phenomena of the "Plague of Wasps" in 1893. It will there be seen that there was an absence of frost after March 23rd, while the total rainfall from March 1st to June 30th, 1893, only amounted to 2·38 inches, with never more than 0·34 inch on any one of the 27 "wet" days of the four months combined.

In 1894 we again had fine warm weather in the early spring, and the female wasps appeared on the wing in great abundance, these individuals being in reality a legacy from last year's plague, and giving further evidence, if such were needed, of the strength and vigour of the nests last season—an abundant supply of food furnished by the thousands of workers having resulted in the feeding up of an unusually large number of perfect females. The daily press was full of warnings to catch these "queens," and nip in the bud any recurrence of the plague! Referring to my own notes I find that I saw the first wasp (sp.?) of the season on the wing as early as February 7th, at Outwell, Cambs. A few were noted during March and more in April, chiefly *Vespa vulgaris* and *V. germanica*, with one or two *V. rufa*. Towards the end of April they became abundant, so much so that a neighbouring hawthorn hedge and oak fence were a source of terror to the nervous. Between May 4th and 7th I captured rather over 50 females: *V. germanica* 40, *V. vulgaris* 8, *V. norvegica* and *V. sylvestris* 2 or 3 each. Towards the end of May the numbers were diminishing. I first saw workers (*V. germanica*) on the wing on June 7th. But the remainder of the year was singularly free from wasps, and as a consequence, in my opinion, aphides and earwigs were present in most destructive abundance.

The weather during the four months above named enables a judgment to be formed on the conditions fatal, or the reverse, to wasp life. Between March 1st and June 30th, 1894, there fell at Godalming 7·76 inches of rain on 56 days—roughly three times as much rain as in the corresponding period of 1893, on only twice as many days—pointing to heavy downpours. As a matter of fact, on six occasions during this time the fall for one day exceeded 0·35 inch. Now it is most remarkable that the heavy fall of rain exactly coincides with the period at

which my notes cease to remark abundance of females. It has been observed already that wasps were plentiful up to May 7th. I note in my weather-chart that on May 11th there fell 0·42 inch of rain, while between May 26th and June 6th (both inclusive) my rain-gauge registered 2·23 inches. It was precisely from this time forward that wasps became conspicuous by their absence. During July they were in no better state, and many nests which had survived till then must have perished by drowning. The total rainfall for that month was 4·86 inches on 21 days; on one occasion 1·59 inch fell, on another 1·13 inch, on a third 0·43 inch, while on July 10th 0·48 inch fell in the short space of ten minutes.

With regard to temperature, the conditions were extremely favourable to wasps. My screened thermometer registered no frost after March 19th. This will be surprising to those who remember the disastrous (horticulturally speaking) frosts of May 21st and 22nd. These, however, were strictly "radiation" frosts. The exposed thermometer on grass fell to 25° F., while that in the screen only reached 32·8° F. Such a frost most assuredly could not affect wasps injuriously, for the very slightest covering was a protection against it, *e.g.*, exposed leaves of potato plants and scarlet runners were blackened and killed, but leaves vertically below these were uninjured.

From these observations it may, I think, be fairly concluded that in spite of favourable conditions of temperature, heavy rains are extremely fatal to wasp communities. It would be interesting to note the effect of the converse conditions, viz., a dry spring and summer accompanied by repeated late frosts of some severity, but for this opportunity we must be content to wait.

The present frost has furnished the opportunity of testing the powers of endurance of cold by hibernating wasps. The results show that, at any rate during the period of hibernation, severe cold has little effect upon their vitality.

January 12.—♀. *V. germanica* placed in corked test tube and embedded in a heap of snow, temperature 31·0° F., for four hours. Completely recovered on being brought into a warm room.

January 13.—Same wasp placed out of doors, temperature 34° F., for one hour, then in heap of snow for one hour, and then for three hours in a vessel containing mixture of snow and salt and surrounded by snow; temperature fell to —6° F. Wasp died.

February 5.—♀. *V. germanica* found in corner of thermometer screen, apparently dead. Completely recovered during examination by a class of pupils on February 8, having been in the screen during the intervening days. Minimum temperatures, February 6, 13·8° F.; February 7, 10·4° F.; February 8, 9·9° F. Maximum temperatures, February 6, 22·7° F.; February 7, 22·3° F.; February 8, 24·8° F.

OSWALD H. LATTER.

Charterhouse, Godalming.

V.

The Structure and Habits of Archæopteryx.

III.—The Feathers.

THE evidence obtainable does not justify the expression of any opinion as to whether the body of *Archæopteryx* was covered with feathers all over or only partially. Three chief kinds of feathers are, however, recognisable in the fossils:—(1) quills, (2) coverts, and (3) contour feathers.

The **quills** are exceedingly well-preserved, especially in the Berlin specimen. The **remiges**, or wing-quills, had the characters of those of many ordinary birds, such as a pigeon. The calamus is not clearly seen, as it is hidden by the coverts; but the narrowing of the vane near the base shows (*e.g.*, in the second and third primary quills of the left wing of the Berlin specimen) that its length was much the same in proportion to the rest of the feather as in the corresponding feathers of a pigeon. The rachis is clearly seen, and is slightly curved so as to render the ventral surface of the wing concave and the dorsal surface convex. It tapers gradually as in feathers of the usual type. The groove seen along the dorsal surface of the rachis is probably due to shrinkage of the medullary substance during fossilisation—but this point is open to dispute. The vane, as in nearly all birds, is curved, the anterior and narrower moiety much more strongly than the posterior, which latter is overlapped dorsally by the anterior portion of the feather next following it. The barbs are easily seen, even in photographs; but I have been unable to make out the barbules with certainty. Their existence, and even that of the hooks which serve to maintain the relative positions of the barbs, is safely to be inferred from the extreme regularity with which the barbs lie side by side in the Berlin specimen.

Of the quills, there are in each wing seven primary and ten secondary. The lengths of the primary quills, *i.e.*, of the quills borne by the metacarpals and phalanges, are as follows (commencing with the first):—65, 90, 120, 125, 135, 130, and 120 mm. The secondary quills, borne by the ulna, are not easy to measure accurately, but they diminish gradually from the carpal region to the elbow. The first is 115 mm. long; the last or tenth, 75 mm. Taken as a whole, these remiges, though less numerous than in most modern birds, are as

perfectly fitted, by their form and arrangement, for the purpose of flight as in, say, a pigeon. Their size, though not difficult to determine absolutely, is difficult, if not impossible to determine relatively to the weight of the body; for in our guesses at the weight of the animal a very large margin must be left for possible error.

The **rectrices**, or tail-quills, differ very remarkably from those of any other known bird. Unfortunately, I overlooked the question as to their number when I was in Berlin. Previous authorities regard them as arranged in pairs, one pair to each vertebra of the tail, but Dames is very cautious on this point. My large photographs suggest that they are somewhat more numerous, but the point is one which may be left for the present undetermined. They differ from the corresponding feathers of modern birds of flight chiefly in size, being very much smaller than those of ordinary birds of equal size. Those of the anterior part of the tail are about 50 mm. long, or perhaps a little less (Berlin specimen). Further back they are longer, the maximum length of about 95 mm. being at about the twelfth caudal vertebra. To what extent, if any, they could be spread out and closed together we can only guess, and the fact that they lie in both specimens at an angle of about 30° to the axis of the tail does not help us much; for, if the animal had the power of spreading its tail-feathers, this would perhaps have been effected by means of a muscle arising from some bone in the pelvic region, through the mediation of a slender tendinous band running along each side of the vertebral column of the tail, and opposed by a slender elastic ligament which would, when the muscle was relaxed, bring the feathers into some such position as that which they occupy in the fossils known to us. These tendons and ligaments may well have been very small, and the absence of any trace of them in the fossils is not sufficient justification for our stating that they did not exist. We must, therefore, remain in ignorance as to whether *Archæopteryx* could or could not spread and close its tail.

Though the feathers are small, their great number gives to the tail, looked upon as an aëroplane, a very considerable surface, and this surface is greatly increased by the development of a series of feathers, which may perhaps be classed as rectrices, along the sides of the hinder part of the trunk. So far as I can make out by means of drawings that I have made to scale of the bird in the flying position, these lateral rows of feathers constitute with the tail-feathers a continuous aëroplane, extending forwards as far as the posterior edge of the extended wings. Why those who have made drawings of the animal "restored" should all, so far as I know, ignore the existence of this lateral aëroplane, and represent the lateral feathers of the tail-series as coming to an end in the tail, is a subject which those who are interested in the origin and multiplication of errors may appropriately consider; but this is not the place for the consideration of it. It is sufficient here to point out that the extant

"restorations" are as utterly wrong and misleading in this respect as they are in others.

Archæopteryx, unlike any other known bird, bore quills on its tibiæ. These are not either remiges or rectrices—and, indeed, the lateral aëroplane in front of the tail is not strictly made up of rectrices. In the absence of a better name, I will call them **tibial quills.** These *appear* to have lain in a single plane, which is the plane of flexion of the leg, the plane in which femur, tibia, and metatarsals all lie when the limb is bent; and they were apparently arranged in two series along the surfaces corresponding to the anterior and posterior surfaces of the human tibia, *i.e.*, the extensor and flexor surfaces. The number of them cannot be made out with certainty. The longest appear to have measured a little over 30 mm. in length. How they were placed in reference to the muscles I cannot say, and though they appear to have lain in a single plane, they may perhaps—though I do not believe it—have been "breeches," as they have been described. They extended along the whole length of the tibia, and certain appearances in the region between the left leg and the tail in the Berlin specimen suggest that the flexor-series extended also to the region of the femur.

Coverts are recognisable with certainty over the primary and secondary quills of the wings, especially the left wing, but they are not nearly so well preserved as the more robust quills. They appear to have been very slender, and now lie at an angle of about 40° to the quills. This deflection may have been due to the action of a stream of water passing over the dead bird when it first came to rest where it was finally fossilised; and, if so, the animal must have come to rest with its head up-stream, as one would naturally suppose.

The appearances in the fossil do not justify any statement as to the coverts in the tail or over the tibial quills.

Contour feathers may be recognised with certainty only in the cervical region. Three are well preserved between the right hand and the label bearing the number 11 in Plate I. (facing p. 122). I believe I have recognised others ventral to the fourth and fifth cervical vertebræ; but this is far from certain. As to the covering of the rest of the body, we are in the dark.

IV.—HABITS.

Archæopteryx was an arboreal quadruped fitted for flight, if not for prolonged flight.

First, as to quadrupedalism and attitude.—I have already (p. 120) pointed out that the digits I, II, III of the hand are long and slender and flexible; and that each metacarpal and phalanx of these digits is curved, the concavity being ventral; and that the tubercles for the insertion of the flexor and extensor muscles of some of these phalanges are distinctly recognisable. To this I would now

add that their joints are at different levels, showing that each finger could be flexed independently of the rest, and therefore that they were *free* and not bound together. I also showed that they did not support the quills, but were free from the wing except at their carpal ends. If they were bound together in the wing they would be inflexible, inasmuch as the joints of each digit are at different levels from those of the other digits.

I have already referred to the long, lizard-like body of the animal, and to the absence of that shifting backwards of the heavy abdominal viscera which is seen in such bipeds as birds, squirrels, kangaroos, dinosaurs, etc.; but I do not wish now to rely upon mere analogy. The form of the body is so clearly shown that it is obvious that its centre of gravity would be in front, not only of the acetabulum, but of the knee. If the animal walked, or even stood, on two feet at all, it would have had to stand either bolt upright or with its dorsal surface directed slightly downwards. Whether the tail would then be on the ground (as in a kangaroo) or in the air (as in a squirrel) is open to doubt, for we do not know enough about the flexibility of its proximal portion to be able to say with certainty whether it could or could not be bent up over the animal's back. The long, heavy neck and the great weight of the head, which was supported by an elastic ligament, as shown by the curvature of the neck in the fossil (as in *Compsognathus* and the pterodactyles), add greatly to the force of this argument. A duck has to walk with its body tipped up almost on end, in spite of the great shifting of the heavy organs of the abdomen backwards between the legs. There is no room for doubt that in *Archæopteryx* the centre of gravity would be much further forward, not only on account of the heavy head and neck, but also on account of the solidity of the wing-bones, as shown by the absence of pneumatic foramina. Let any who doubt the justice of this argument compare the pelvis as seen in Plate II. (which the authorities of the British Museum have kindly allowed to be prepared in illustration of this article) with the pelvis of, say, a pigeon or a dinosaur, or any other animal whatever capable of walking on two limbs in any but an erect position. The small size of the cnemial crests, moreover, forbids us to believe that the hind-limbs alone were able to bear the weight of the body when the knee was bent.

This bird was not only not a biped, but it did not walk on the ground at all. It would have been as helpless on the ground as a bat or even a sloth. The great length of the hind-limbs and shortness of the fore-limbs, at any rate when these latter were so flexed as to keep the feathers off the ground; the position of the shoulder joint, and especially of the articular surface of the humerus: these render the animal unfit for such a habit as even quadrupedal locomotion on the ground. The perfect state of the wing-quills at their tips shows that they were not brought habitually into contact with the ground, and I

know of no rational argument in favour of the view that the animal did live largely upon the ground. For quadrupedal locomotion in trees the animal is admirably adapted. Long, flexible digits, provided with claws on all four limbs, fit it at least as perfectly to arboreal quadrupedalism as *Galeopithecus* or *Petaurus* or any other "flying" mammal; and I think, from the greater length and flexibility of those digits, fit it even more perfectly for such a habit than even these mammals, and incomparably more so than the bats with their backwardly-directed hind limbs, which, while they serve to enable the animal to hold on to the tree or other body, are so modified for the support of the wing as to be of little use for quadrupedal locomotion.

As to flight.—*Archæopteryx*, though less well fitted for prolonged flight than most modern birds, was certainly capable of flight. As some have maintained that it was well fitted for powerful and prolonged flight, I will mention the features pointing to an opposite conclusion. The absence of a pectoral crest on the humerus, the small size of the sternum (*see* p. 115), and consequent relatively small size of the great pectoral muscle, indicate a deficiency of propulsive and sustaining power in flight. The absence of pneumatic foramina and consequent absence of air-cavities in the wing-bones show that rapid to and fro (*i.e.*, up and down) movement of the wing would involve a larger amount of exertion than in a wing with hollow bones as in most modern birds. It is not so much the extra weight that would be impedimental as the extra inertia. The narrowness of the body and smallness of the sternum indicate that the air-cavities of the abdomen, even if present, were smaller and less effective for respiration than in modern birds. I may be permitted here to make a remark as to the use of abdominal air-sacs in birds, or I may be suspected of having fallen into an old error of supposing that they materially diminish the weight of the bird. Flight involves, perhaps, a greater, *i.e.*, more rapid, consumption of energy than any other form of locomotion, and all powerful fliers, whether birds or insects, are provided with respiratory organs of enormous effectiveness. In birds, instead of air being only pumped into the bronchial tubes and the rest being left to diffusion, the air is drawn right through the lungs into the abdominal and other air-sacs, so that the highly vascular lung with its venous blood supply is brought into more direct relation with the "tidal air" than in mammals, while the "residual air," which is not changed at each double respiratory movement, rests, not, as in mammals, in the lung itself, or at least not chiefly so, but in the air-sacs outside the lungs. The respiratory organ proper is thus brought into direct relation with air capable of far more rapid renewal than in the mammalian lung. In other words, birds breathe the tidal air, while mammals breathe the residual air. *Archæopteryx*, however, shows no sign of the possession of large air-sacs, or of that large expanded sternum which, in modern birds of flight, insures the rapid change of the air by the same

ARCHÆOPTERYX.

From a photograph, one-quarter natural size, of the specimen in the British Museum (Natural History), taken by kind permission of Dr. Henry Woodward, F.R.S., Keeper of the Geological Department.

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muscular movements as are involved in flight itself. While in all powerful fliers, both birds and insects, every movement of the wing insures a change of the air in the respiratory organ itself (and not merely in the passages leading to that organ), the form and structure of *Archæopteryx* forbid us to believe that such an adaptation existed in it.

Conclusions as to the size and efficiency of the heart might be drawn, but they are not only obvious but also perhaps a little risky; so I will leave them.

Nobody, except the constructors of flying-machines, seems to be ignorant of the fact that all powerful fliers have a wing-area which is very large in proportion to the area of the immoveable aëroplanes. Birds do not nowadays rely upon immoveable aëroplanes at all. The wings serve all the functions of both propulsion and sustentation, and the tail when used at all is used only for steering; while the vastly superior flight of insects is effected in the absence of any special steering apparatus, the wings themselves serving alike for propulsion, sustentation, and steering.

In *Archæopteryx*, then, we find an animal as yet not evolved beyond the aëroplane phase of flight; a phase characterised by the use of large aëroplanes, which, while offering considerable resistance to flight, take no part in the propulsion. It may further be pointed out that among flying things, whether birds, mammals, insects, or flying machines, the most efficient are all far broader from side to side than they are long. Lilienthal, alone among men who seek to fly, seems to have appreciated the real bearing of this fact. The further mechanical consideration of the point, even as applied to *Archæopteryx*, would, however, take us too far. It is sufficient for my present purpose to have pointed out wide differences of structure both as to the immediate organs of flight and also as to the propelling muscles and the respiratory organs on which powerful flight depends, between, on the one hand, *Archæopteryx*, and, on the other hand, all other flying animals. I will only add an argument for the benefit of biologists who may be unable to grasp the significance of mechanical considerations. The oldest known bird—*Archæopteryx*—was constructed, so far as the sustentatory apparatus of flight was concerned, on a principle which has been superseded in all modern birds, and which may therefore be safely pronounced, even on purely biological grounds, to be inferior in effectiveness to the principle of construction which has superseded it.

Archæopteryx was, therefore, not a very good flier. How good it was as a flier, I dare not guess; though the perfect, but all too small, wings strongly suggest that, in spite of the impediments I have mentioned (free digits, heavy head and neck, large aëroplanes offering resistance to rapid movement, small muscles, heavy non-pneumatic bones, and deficient respiratory apparatus), *Archæopteryx* could fly better than the competing pterodactyles.

Since the days of *Archæopteryx*, its descendants, or the descendants of its near relatives, have been evolved into the modern bird, which, in its more perfect forms, is a perfect biped and a powerful flier; and a brief enumeration of some of the chief changes involved in that evolution will throw an additional light upon my contention as to the comparatively small power of flight, and as to the quadrupedal locomotion of *Archæopteryx*. The shoulder has shifted backwards, the trunk has become shorter, bringing both elbow and knee-joints nearer the centre of gravity; thereby rendering balance in walking or standing independent of the aid of the fore-limb. The fore-limb, in accordance with this release from one of its functions, has lost the digits I, II, and III on which that function depended, and has thus been reduced in inertia, while the pelvis has become widened to allow for the backward displacement of the abdominal viscera, and the tibia has acquired a cnemial crest of much greater size, enabling the hind-limb to support the weight of the whole body, with the knee flexed and placed in such position that the centre of gravity is behind it. The aëroplanes of the tibiæ have been abolished, and that of the tail shortened, lightened, and reduced to a steering apparatus pure and simple. The wings have gained in size; their inertia has been reduced by the development of air-cavities in the wing-bones; more powerful muscles have been evolved for the movement of the wings, and this has involved the development of a pectoral crest and of a large sternum. The reduction in weight of the head (especially jaws) has aided in the backward shifting of the centre of gravity. The development of the large sternum has facilitated the evolution of a respiratory apparatus of more efficient type, and the shortening of the whole body and concentration of its weight near one point, aided by the stiffening of the back—often by ankylosis of the vertebræ and always by the increase in length of the functional "sacrum"—has rendered the support of the hinder part of the body by cumbrous aëroplanes unnecessary.

This is by no means all that might properly be urged in favour of the views I have expressed, but I fear to make my discussion too long.

C. Herbert Hurst.

(*To be continued.*)

VI.

An Eelworm Disease of Hops.

IN September, 1894, NATURAL SCIENCE (vol. v., p. 170) was good enough to draw the attention of its readers to my investigation of a new disease, which causes hops to become what is termed "nettle-headed," and which during the last two or three years has been giving a considerable amount of trouble to growers in several of the hop districts of Kent.

The following paper is the more extensive communication which was then promised to this Review. Last July I was asked to examine some of the affected plants, and since that date have been busily engaged in investigating the matter. The results of the work are, I venture to think, of the greatest importance, as the disease, if thoroughly established, promises to become one possessing serious consequences to the hop-grower.

The exact distribution of the disease in the county I have not been able to learn, owing to want of accurate observation and description on the part of the growers, and also to the inherent difficulty of distinguishing the disease in its early stages from obscure pathological conditions induced by unfavourable soil and manures. However, where it has been known for some time it has assumed a more virulent character, with well-marked characteristic symptoms. Affected plants are said to be "nettle-headed," "silly," or "skinkly." Isolated examples seem to have been noticed as long ago as 1880, but these cases did not extend beyond very small areas in the gardens. Lately, however, the disease has spread considerably, and necessitated the complete uprooting and destruction of several acres of plants in various localities. One correspondent informs me that it first appeared in old plantations of "Colegates," and spread to such an extent that this variety has almost gone out of cultivation. Almost all varieties are subject to attack, but there is a general consensus of opinion that the early kinds suffer most, and especially on loamy soils. The worst cases are met with in old gardens, and the disease is rarely noticed on a serious scale until five or six years after planting. I have, however, seen plants attacked in the second year, and this may become the rule rather than the exception.

The parts above ground in a typically diseased specimen show a marked want of vitality, although this stunting of growth is not

evident until about the end of June, when the stem or bine has grown some distance up the pole. Then the bine becomes slack, and loses its power of twining. The head of the plant hangs away from the pole, and if the plant is not retied at a higher point the whole mass of stem and leaves slides down into a heap on the ground. When this stage is reached, further growth and development are arrested, the plant becomes worthless, and is generally grubbed. Those specimens which show symptoms of disease one year are almost invariably worse the following summer. What the ultimate result is I have not been able to learn from direct observation, but I am informed that the plant dies away altogether.

Stages between apparent health and complete ruin are always to be met with. It is not infrequent to observe some bines diseased, which are nevertheless sufficiently strong to reach the top of the pole, and even to yield a moderate quantity of hops; but by far the larger number in an infected garden are overcome before reaching this stage. Upon the same "hill" it may often be noticed that some bines topple over, and others remain normal. The diseased and normal stems in such instances generally grow from different "sets," and the cures said to have been produced by cutting off the affected bines and tying up others may be explained by a consideration of this fact. In one or two cases, however, I have noticed two bines springing from opposite sides of the same root stock, one of which showed symptoms of disease, and the other an apparently healthy growth.

In a diseased plant the stem not only loses its twining power but tapers rapidly, becoming very thin; the branches and young shoots also have the same extremely thin character, and the internodes of the plant are shortened, so that the leaves become more crowded than in healthy bines. The growth in length of the fibro-vascular system, or woody parts, all through the plant seems to be arrested.

The most characteristic symptom of the disease is the peculiar leaf development. The earlier leaves differ little from the ordinary type, and die a natural death. Those formed later are, however, very much smaller than usual, often darker in colour, and their edges curl towards the upper surface. (Plate III., Fig. I., *b*). The "veins" on the under surface stand out from the soft tissue in a marked degree (Plate III., Fig. I., *a*), and this, together with a slight puckering and increased serration of the leaf, makes it closely resemble the leaf of the stinging-nettle. On holding a leaf up to the light and viewing the under-side, the chief veins are seen to be drawn together at the angles where they branch from one another, and between them at these points are noticed yellowish transparent patches of thinner tissue. These patches are surrounded by thicker dark-green tissue, which also extends along the sides of the veins for a short distance. These are the first indications of the disease, and arise generally at the edges of the leaf and then extend backward along the sides of the veins to the middle and even to the base of the leaf-blade. Before curling

takes place leaves exhibit this peculiarity, and although all which subsequently curl and die do not show it, I have never seen a case of true "nettle-headed" hop without the leaves about half-way up the bine being altered in this manner. Moreover, these changes take place in regular order after their first appearance, being always met with in leaves belonging to successive nodes and never at random on the stem. A cross section of the leaf at these altered points shows an abnormal production of "palisade" parenchyma, extending about half-way round on each side of the fibro-vascular bundle, and giving a darker green appearance (Plate III., Fig. II.). In some cases increased growth of soft tissue goes on until a very minute leaf-blade is produced on the side of the fibro-vascular bundle (Plate III., Fig. III.). In the lighter parts between the veins, the tissue shows no distinct differentiation into "palisade" and "spongy" parenchyma. This peculiarity may be brought about by strains in the older parts, caused by the subsequent growth of new tissue, but I have not had time to follow the development completely.

It was the discovery of the shortening of the fibro-vascular system in the young shoots and leaves, and of the concomitant increased cell-division in the leaf, leading to the abnormal production of parenchyma along the sides of the circulatory system there, that led me at once to suspect that nematodes, or eelworms, were at work in the root. Although such features are not invariably met with in all attacks by nematodes, in a large number of instances I have found such to occur. Complete diseased plants were kindly supplied to me by several growers, and an examination of the roots led to the discovery of large numbers of eelworms in different parts of the cortex and young root-fibrils. The parasites belong to the family of Anguillulidæ, and are representatives of two distinct genera, the respective species being *Tylenchus devastatrix* (Kühn), known as the "stem eelworm," and *Heterodera schachtii*, A. Schm, the much-dreaded "sugar-beet eelworm."

So far as I am aware, no species of eelworm has previously been recorded as attacking the hop in any part of the world; nor has *Tylenchus devastatrix* ever been met with in the roots of any kind of plant. It is, I believe, also the first appearance of the "beet" eelworm in the British Isles, although its ally, the "root-knot" eelworm, *Heterodera radicicola* (Greeff) Müller, is a well-known pest of cucumbers, tomatoes, and various other plants.

The *Tylenchi* occur in the thicker parts of the roots and live within the cortex, destroying it, and making their way close up to the living bast. They are not uniformly distributed all over the root, but only in isolated patches, and contrary to their usual behaviour when met with in stems and leaves of plants, produce no excessive growth of tissue in their immediate neighbourhood. Where they are present the cortex loses its bright orange colour, decay sets in, and the root at that point is generally found to have an eccentric develop-

ment of the woody rings of growth. The cells round about the parasites die, turn brown, and become disorganised; thus small open spaces are formed in the living cortex (Plate, Fig. V.). Many of the cells become filled with a dark-brown resinous substance.

Knowing the extreme similarity of many of these nematodes, especially in the larval state, and the consequent difficulty of accurate identification of the species, I asked Dr. de Man, of Ierseke, and Dr. J. Ritzema Bos, Wageningen, Netherlands, to examine them. Both gentlemen kindly did so, and pronounced the *Tylenchus* to be *T. devastatrix*. Dr. Ritzema Bos, who has made a special study of this particular species, was at first inclined to believe that the hop-root *Tylenchus*, although very nearly allied to *T. devastatrix*, was not identical with it. On more careful examination, however, he informs me that he can find no constant difference between the two species, except that the hop-root variety is smaller than any he has seen in other plants.

It is worthy of note that males and larvæ are much more abundant than females in all the cases I have examined.

The *Heterodera* females I first discovered loose in the cortex of the thicker roots, along with *Tylenchus*-like larvæ, which no doubt belonged to *H. schachtii*, but which at the time I was unable to identify with certainty. There was, however, no difficulty in recognising the motionless citron-shaped females as of this species. Subsequent examination showed that these had become detached from finer rootlets, which, in a large number of instances, are found to grow and permeate the decaying bark of the root, instead of making their way into the soil.

An examination of the finer rootlets of well-marked "nettle-headed" plants revealed the presence of females of the *Heterodera* in thousands on all the younger fibrils, even among the root-hairs. They are readily seen with a pocket lens or with the naked eye as whitish points about the size of a very small pin's head, seated on the outside of the rootlet (Plate, Fig. VI.), and even distributed in the soil close by. In older stages they are a rich chestnut-brown, considerably darker than the root epidermis. Developing beneath the epidermis, they swell up and ultimately break through it, and become exposed on the outside of the root (Plate, Fig. VII.). The delicate youngest roots are seriously injured in this way, and with an ordinary lens the older fine root-fibrils are seen to be covered with minute holes and slits, the work of former generations of the nematode. With a slightly higher magnifying power all the various stages of growth of the female may be observed on the root. The rootlets are slightly thicker and more stumpy in character than usual, and not so copiously branched as in healthy plants. Nothing, however, like the galls of *H. radicicola* is produced, nor are the parasites so far embedded in the tissues of the plant, as is usual with the latter species. Dr. de Man found dead females in pieces of roots which I forwarded to him; and

at a later date he examined fresh specimens and males, and stated them to be *Heterodera schachtii*. Dr. Adolf Strubell, of Bonn University, who has monographed this species, and Dr. A. Voigt, kindly examined examples, and reported to the same effect. Here, however, it may be mentioned that, as with the *Tylenchus*, the specimens on the hop-roots are considerably smaller than those occurring on other plants, and attack rootlets much thinner than usual. The females measured by Dr. de Man measured from 0·5 to 0·6 mm. long (Dr. Strubell's measurements on females from beetroot, etc., are 0·8 to 1·03 mm.). Detached from the rootlets and examined with the microscope, they are observed to be like a lemon in shape, white or brown according to age, and too opaque for the contents to be seen clearly (Plate, Fig. VIII., *a*). On pressing one between a cover-slip and glass side, the eggs, numbering from 200 to 300, can be squeezed out of the dead body-cavity (Plate, Fig. VIII., *b*). The eggs are somewhat bean-shaped (Plate, Figg. VIII. and IX.), about 0·096 to 0·11 mm. long ($\frac{1}{250}$ of an inch), and about half as broad, and go through their development in the body of the mother. The parasite is viviparous, and it is not infrequent to obtain from the same female both free completely formed larvæ, and eggs only partially hatched.

The larvæ, which are eel- or *Tylenchus*-like, leave the body-cavity in which they develop, and, according to the researches of Kühn, Strubell, and others, wander but a short time in the soil, soon finding their way to a fine root close at hand. Here they pierce the epidermis by means of a comparatively large spike which they can extrude from the mouth, and then wriggle their way into the soft parenchyma surrounding the central bundle of the root. They then come to rest after casting their skin, live upon the root-sap, and lose their eelworm shape, becoming plumper in form. At this stage the sexes are differentiated, and the females continue to swell and grow beneath the epidermis, until the pressure is sufficient to lift up and rupture the outer cell-layers of the root. In this manner they become exposed, only the head remaining in the root-substance. The females are never eel-like, nor do they move freely. The males develop from the enlarged resting larvæ by contraction of the contents of the latter and subsequent formation of a new membrane. Although, as larvæ, they swell and lift up the soft tissue by which they are surrounded to a considerable extent, they do not break through the epidermis like the females, but, after assuming a *Tylenchus*- or eel-like shape within the old case or cyst of larval-skin in the rootlet, they pierce their way outward, and after fertilising the female they die. Their life is very short—only four or five days—and thus casual observations of the male are less frequent.

The whole life-cycle of the parasite from the egg to the adult condition occupies about four weeks, so that a large number of generations are possible in a year.

It is a matter of considerable interest to find two distinct species

of parasitic nematodes present in the hop roots. The exact part which each plays in the disease it is impossible to decide without carrying out a series of infection experiments, and such are now in progress. Neither species finds its way into the stems or leaves of the hop; and, judging from their position, manner, and rate of development, the peculiar changes observed in the leaves are no doubt to be attributed to the secretions of the worms being carried there in the ascending current of sap.

The *Tylenchus* is one of the causes of clover "stem-sickness" and "tulip-root" of oats, and is also met with in stems of buckwheat, rye, hyacinths, onions, and several other plants. The *Heterodera schachtii* is the cause of "beet-sickness," and is also known to attack and live upon the roots of all cereals, and practically all cruciferous crops, as turnip, cabbage, kohl-rabi, mustard, etc. Lately some leguminous crops have been attacked. Potatoes and all Compositæ (in which Order the artichoke, lettuce, and salsify are the chief food-plants) seem to be free from injury by this parasite.

With regard to remedies, it may be remarked at the outset that there is no known method of exterminating these nematodes from the soil when once they have become established there, and consequently it becomes imperative to call attention to the necessity for dealing summarily with the pest in the earliest manifestations of this new disease.

Thousands of experiments have been made on the Continent with a view of eradicating the *Heterodera* from the sugar-beet fields, but without success. The most satisfactory means of keeping it within bounds was suggested by Kühn after his researches in 1881, and his plan has so far yielded the best results, although it is no cure. He finds that the larvæ, after entering the roots of plants, require at one stage of their development considerable quantities of food. If this supply is cut short, the parasite dies before reaching maturity and before the fertilisation of the females has taken place. "Trap-plants" are grown, the most suitable being summer rape, on account of its extensive root-system, easy infection, and rapidity with which it dies when disturbed. After the larvæ have entered the rootlets and reached a certain stage of growth, the crop is destroyed, and with it all the immature parasites. A repetition of this process three or four times during the summer cleans the ground of most of the parasites, and a remunerative crop of beet can then be taken off in the ordinary course of cultivation for some time before the "sickness" shows itself again to any serious extent. To reduce the expense of idle ground, a rapidly-growing crop of potatoes is taken off in midsummer. It is obvious, of course, that such a process is not applicable to hop-gardens where the plants remain on the ground several years, but some such scheme must be adopted in order to clean the ground after grubbing a badly attacked garden. There is hope in a properly selected rotation of crops for diminishing the number of nematodes in

the soil, but it is important that no crop should be grown which is known to be subject to attacks of *Heterodera schachtii*, or *Tylenchus devastatrix*, until the ground has been thoroughly cleaned in this manner. The evil effects of planting hops on the site of old gardens which have been grubbed only a year previously on account of the disease, I have witnessed more than once. Both the theory and practice of cleaning the ground by Kühn's method are good, but much of its success depends upon the estimation of the correct time at which the destruction of the "trap plants" should take place, and this can only be determined by an examination of the root, which requires a certain amount of skill in the use of the microscope.

The mature parasites are not more than a twenty-fifth part of an inch long, and the larvæ and eggs very much smaller. The minute character of the pest, coupled with its great reproductive power, makes it very difficult to deal with by direct application of poisonous chemical substances. Much of the life is passed inside the delicate roots of the plant. Moreover, the eggs are protected during their development by the dead leathery chitinous body of the female, and would not be injured by solutions strong enough to destroy the free larvæ in the soil.

The addition of chemical substances, such as carbon disulphide and gas-water, to the soil, apart from the cost of saturating the latter to any appreciable depth, would not be suitable in the case of growing hops suffering from the disease, since these substances are injurious to plants. Application of alkaline solutions and alkaline salts to the soil as manures has met with some success at the experimental stations in France and Germany, and these are to be recommended. Top-dressing in spring with muriate of potash or sulphate of potash has been found most beneficial; kainite, which is a hydrous magnesium sulphate with potassium chloride, has not been so satisfactory. Liming, in some instances, and working in of salt have diminished the evil effects of the parasites, and the former process should be tried, especially where the soil is full of humus from the indiscriminate use of large quantities of organic manures. As soon as an affected plant is seen in a garden it should be grubbed and burnt on the spot, and quicklime applied to the ground in the immediate neighbourhood. All implements used in cultivating infected gardens should be properly cleaned before being used among healthy crops, and the planting of "sets" taken from infected gardens should be discontinued.

It is difficult to determine the rate at which the parasites would naturally spread if left to themselves; there is no doubt that the parasites are at present largely carried from "hill" to "hill" by the incessant cultivation which goes on in the hop-garden.

Owing to the great extent of the root-system of the hop-plant and its rapidly growing and recuperative powers, it takes a considerable time before a plant is totally disabled and rendered useless;

but there is danger in the fact that many growers have allowed the plants to grow as long as any hops were produced, and thus the roots and ground have become thoroughly permeated with the parasites before steps have been taken to eradicate the evil. This is a bad policy, not only because the plant becomes a centre of infection for the immediate neighbourhood, but also because there is some evidence that by such unconscious rearing of successive generations of these nematodes upon one kind of plant, a new "race," so to speak, is raised, which becomes more virulent in its action and more completely adapted to its surroundings.

It is perhaps necessary to point out that the soil of a hop-garden teems with living organisms on account of the excessively large amount of humus present, due to the use of heterogeneous organic substances as manures (sprats, star-fish, leather, wool, fur waste, etc.), and enormous numbers of free-living non-parasitic nematodes are met with. Such fungi as live on decaying vegetable matter, especially those imperfect conidial forms belonging to the group *Hyphomycetes*, are also very abundant, both in the soil and upon every dying and dead leaf throughout the gardens.

In order that credit may be given to whom credit is due, I take the opportunity of claiming priority for an early English observer whose work on the subject of nematodes in root-galls has escaped the notice of continental writers. I refer to the late Rev. M. J. Berkeley.

Schacht, in 1859, while investigating diseased sugar-beet plants, became acquainted with peculiar white points upon the outside of the finer rootlets, and ultimately found that these were "sacs" filled with eggs and larvæ of an eelworm. In 1862 he discovered free male nematodes in the soil, which from their close similarity to the embryo worms obtained from the "sacs," he concluded belonged to the same species. Although he was informed by Lieberkühn and Wagener that it was a new species, he gave no name to the worm, and little notice was taken of his discovery until 1871, when A. Schmidt worked at the parasite. A complete study of the development was made, and although his observations were faulty in one or two minor zoological points, Schmidt nevertheless established the remarkable dimorphism which exists between male and female. As has previously been pointed out, the sexes differ so much in size and shape that were the development unknown the relationship of the two forms would readily be overlooked. Schmidt gave a name to the parasite, calling it *Heterodera schachtii*—a new species of a new genus. Kühn (1881), Strubell (1886), and others, have since cleared up the obscure points in its life-history.

Between the time of Schacht's last paper in 1862 and Schmidt's work in 1871, another species of eelworm had been seen by Greeff in 1864 in root-galls on certain grasses; and again, in 1870, by Magnus, in excrescences upon the roots of *Dodartia orientalis*. Greeff looked

upon these eelworms and Schacht's species as belonging either to the genus *Dorylaimus* or to *Anguillula*. Ultimately he named the species *Anguillula radicicola*, and from the measurements which he gave (female, 2 mm. long and ·095 broad, male somewhat smaller), it is evident that as late as 1872 he either did not notice or did not understand the nature of the "cysts" in which the nematodes are met with in the root-galls under observation. The difficulty of realising the exact nature of the so-called "cysts" in the root-galls, even when they were observed, may readily be appreciated by imagining the free females of *H. schachtii* embedded in the hypertrophied tissue of a plant. The eggs and free larvæ would in such a case be easily observed on cutting a section, but the dead chitinous membrane forming the body of the female might be looked upon as belonging to the altered tissues of the plant. The free nematodes would then be

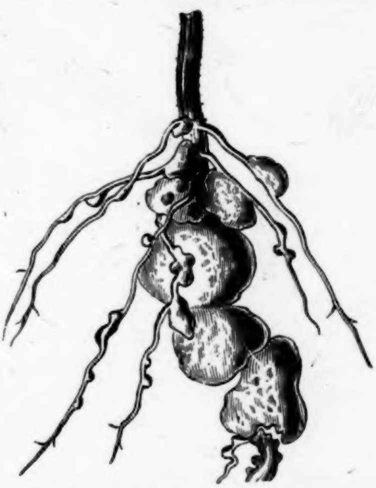


FIG 1.—Root-galls of cucumber plant caused by eelworms (*Heterodera*). From the Rev. M. J. Berkeley's paper in *Gardeners' Chronicle*, April 7, 1855.

classed in the ordinary *Tylenchus*-like groups. This mistake was made by practically all the earlier observers, until the matter was cleared up in 1883 by the work of Frank and Müller; the latter showing that Greeff's *Anguillula* was really a *Heterodera*, which he named *H. radicicola*.

In all the papers upon *Heterodera*, Greeff is credited with the first discovery of eelworms in root-galls of plants; but while examining the literature in connection with this subject, my attention was called by Mr. Carruthers to a paper by the Rev. M. J. Berkeley in the *Gardeners' Chronicle* of April 7, 1855, which clearly shows that this view is an error. Berkeley's observations were made upon the diseased roots of cucumbers nearly ten years before Greeff's discovery, and even four years before Schacht's notice of the beet eel-

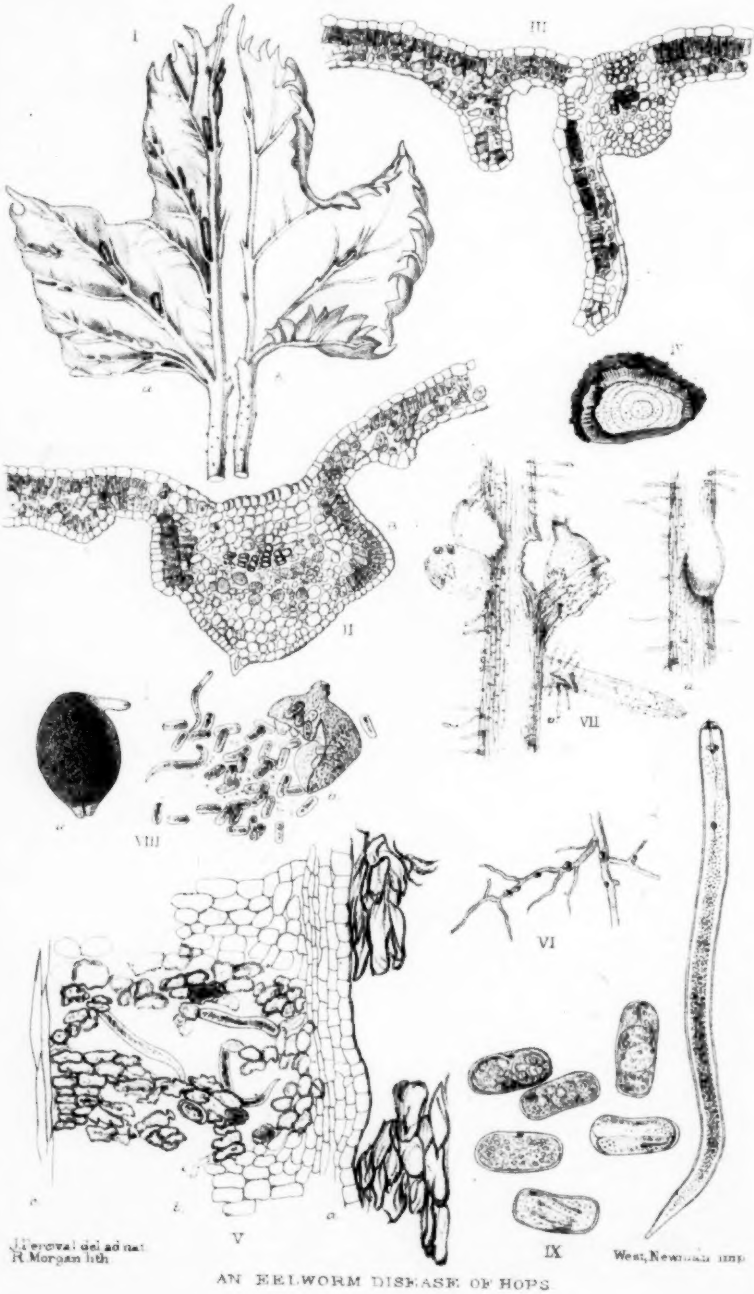
worm. Not only does the English observer note the occurrence of nematodes in root-excrescences for the first time, but gives two figures in his paper, here reprinted by kind permission of the editor of the *Gardeners' Chronicle*. One of them is an enlarged view of what is now recognised as a female of *Heterodera radicicola* embedded in the hypertrophied tissue of the root. Eggs and young larvæ are figured, and Berkeley mentions that these occur in free cyst-like bodies, which appear to be regular membranous sacs.

"The cyst," he says, "was destitute of any evident organic structure, was not affected by iodine and sulphuric acid, but showed some appearance of giving way under caustic potash. It was clear, then, that it did not consist of cellulose, but might possibly be some

FIG. 2.—"Cyst" female *Heterodera* from root-galls of Fig. 1, with eggs and young larvæ.
From the Rev. M. J. Berkeley's paper in *Gardeners' Chronicle*, April 7, 1855.

modification of xylogen. It is not conceivable that such a cyst could have been deposited by the vibrio itself, and we must therefore consider it as due to the irritation caused by the presence of the eggs, and exactly analogous to the cysts produced by the larvæ of the cestoid worms in animal structures. We are not aware that anything of the kind has ever been observed before in vegetable parasites; for, though the tissues of vegetables are greatly altered by the presence of the larvæ, which produce galls, it does not appear that they ever give rise to a free cyst, as in the present case, differing altogether from the surrounding tissues."

It is obvious that although Berkeley looked upon the body of the female as a cyst, his careful attempts to ascertain its nature by chemical means placed him within measurable distance of clearing



J. Percival del ad nat.
R. Morgan lith.

West, Newman imp.

AN EELWORM DISEASE OF HOPS.

up what remained an imperfectly understood phenomenon for more than a quarter of a century.

In conclusion, I wish to express my thanks to the Keeper of the Botanical Department of the Natural History Museum and to Mr. George Murray, for aid and for permission to work in the laboratory of that institution.

South-Eastern Agricultural College, Wye, Kent. J. PERCIVAL.

EXPLANATION OF PLATE III.

I.—*a*, Under, *b* upper surface of leaf from "nettle-headed hop," showing characteristic curling of edges and puckering of veins. Natural size.

II.—Transverse section of leaf, showing abnormal development of tissue at A and B. Magnified forty times.

III.—As in II., showing further growth of tissue at side of midrib. Magnified about forty times.

IV.—Transverse section of root, showing injured cortex and irregular growth at points where *Tylenchus devastatrix*, Kühn, appears. Natural size.

V.—Radial longitudinal section of IV., showing *Tylenchus devastatrix* in cortex. *a*, cork cambium; *b*, cortex; *c*, bast. Magnified.

VI.—Hop rootlet, with attached females of *Heterodera schachtii*. Natural size.

VII.—Hop rootlets, with *Heterodera schachtii* females; (*a*), beneath epidermis; (*b*), exposed after breaking through epidermis. Magnified.

VIII.—*a*, Female of *H. schachtii*; *b*, the same after rupture of female under cover-glass, showing eggs and larvæ. Magnified.

IX.—Eggs in different stages of development, and free young larvæ of *Heterodera schachtii*, showing exsertile mouth-spear. Magnified about 250 times.

SOME NEW BOOKS.

Andrew Crombie Ramsay.

Memoir of Sir Andrew Crombie Ramsay. By Sir Archibald Geikie. 8vo. Pp. xii., 397, with 13 plates. London: Macmillan & Co., 1895. Price 12s. 6d. nett.

This biography of the late Director of the Geological Survey of Great Britain and Ireland, by the distinguished pen of his successor in the office, will not disappoint the geologists who have eagerly awaited it. To all interested in the noble science of geology, and especially to those concerned with British geology, the book will prove first of all a treat to read, and then a valuable, indeed an indispensable, work to place on their shelves for future reference. Our own circle of readers need not be reminded of the scientific labours of Ramsay, his detailed and masterly field-work—chiefly in Wales, his philosophical studies in the stratigraphy of our islands, his restoration of vanished geographies, and his far-reaching theories of denudation by rain, rivers, and above all by ice. Many indeed who know nothing further of geology have read with profound interest his charming volume on the Physical Geology and Geography of Great Britain. But his work as a geologist was far more than ever met the public eye, work in the field, in the office, and in the lecture-room; and the man himself was greater than his work.

But the volume before us does not give merely the details of Ramsay's own life and a sketch of his labours as a geologist; it is a storehouse of information for all who desire to learn something of that great institution, the Geological Survey, and the establishments now or formerly connected therewith, namely, the Museum of Practical Geology and the School of Mines. Among the many figures that are brought vividly before us in these pages, next to Ramsay himself, none stands out more prominently or more lovably than the gifted man who was the instigator, the founder, and the first head of these institutions, Sir Henry Thomas De la Beche, the Father of British Official Geology. It was harder work then than it is now, to fight against an economical Government and "the eternal 'No' of the Treasury"; harder work, too, to enforce the claims of the investigation of earth-structure and earth-history, in days when "earth" and "dirt" were hardly discriminated, and when polite society regarded the geologist in much the same light as the collier or the quarryman. In enthusiastic and humorous sentences, Sir Archibald sketches the life of a "Royal Hammerer." Many are the curious characters for which the itinerant geologist is mistaken, sometimes by an ignorant peasantry, sometimes, with direr consequences, by gamekeepers and policemen. The funniest story is that told of "one of the staff who, poking about to see the rocks exposed on the outskirts of a village in Cumberland, was greeted by an old woman as the 'sanitary 'spector.' He modestly disclaimed the honour, but noticing that the place was

very filthy, ventured to hint that such an official would find something to do there. And he thereupon began to enlarge on the evils of accumulating filth, resulting, among other things, in an unhealthy and stunted population. His auditor heard him out, and then, calmly surveying him from head to foot, remarked, 'Well, young man, all I have to tell ye is that the men o' this place are a deal bigger and stronger and handsomer nor you.' She bore no malice, for she offered him a cup of tea, but he was too cowed to face her any longer."

In dealing with a subject so wide as the growth of the Geological Survey, with which growth Ramsay was so intimately bound up, the historian and biographer has naturally to mention a large number of individuals whose names, though familiar enough to the professed geologist, may be no longer known to the public of amateurs. Each of these, as he is first mentioned, is introduced to the reader in a footnote, while a dozen of them have the additional honour of an excellent portrait. From this point of view, the book, provided as it is with an exhaustive index, may serve as a biographical dictionary to the mesozoic period of the history of British geology. The best of the portraits are those of De la Beche, Murchison, Richard Gibbs (the Survey collector), Thomas Oldham, and J. W. Salter.

Not only geologists, but many other celebrities, are met with herein, outlined in Ramsay's own picturesque phrases. Many, too, are the glimpses that we get of social, scientific, and scientifico-social assemblies—the Red Lion Club, the Geological Society, the "Wisdom meeting," now known as the British Ass, the dinners of the Survey and of the Geological Club, the Royal Institution and others. Murchison asks young Ramsay to breakfast, when he first comes to London—"His house is a splendid one. They are quite people of fashion, but, notwithstanding, Mrs. M. is a kindly body, and made me quite at ease at once." At dinner there he meets "Mr. Featherstonhaugh, the American plenipotentiary, . . . a lively man, but takes no wine for his stomach's sake." Dean Buckland condescended to make Ramsay's acquaintance—"So I was introduced, and the Doctor gave me two of his digits to shake." This was at a meeting of the Geological Society, and the discussion continued till eleven; is it for suburban trains that the meetings nowadays are always "closured" at ten, or are geologists more married than they used to be? At the Royal Institution, this day forty-six years ago, Owen lectured on Limbs; Ramsay stood on the steps—"the theatre was quite full. I saw many I knew: Dr. Fitton looking good-humoured, Sir Roderick looking anxious to keep awake, Dr. Mantell looking eager, Dr. Macdonald looking jolly and anxious for a hole in Owen's coat, Sir Henry looking attentive and queer when Owen came to the peroration, Sir Charles and Lady Lyell looking knightly, Lady S—— looking vulgar, Nicol looking Scotch, with a doubt in his eye, and Mrs. F—— looking at her dress." When Murchison lectured at the same place, he "was quite nervous in the early part of his lecture." Forbes, on the other hand, "lectured in first-rate style, coolly and boldly." "The Astronomer Royal lectured to a crowded audience, Prince Albert in the chair. Airy forgot himself, and lectured an hour and three-quarters! The Prince fell asleep." When Ramsay himself first lectured there, "Faraday ran up to him at the close, shook him by both hands, and asked 'Where *did* you learn to lecture?'" Shortly before the Museum in Jermyn Street was opened, it was inspected by many great people. Among others by Lord and Lady John Russell. "He, cold and uninterested; she, most charming and

intelligent. When I was introduced, he merely bowed coldly. Ditto to all. Blewitt, the M.P. for Monmouth, he coldly bowed to. 'Who would have thought,' said Blewitt, 'that I've sat beside that man and supported him for fourteen years; he is a nice man to keep a party together!'" About Disraeli we are told this story,—"Vernon Harcourt asked a Conservative friend, 'How can you and your party follow such a man?' 'We look on him as a professional bowler,' was the reply." There is an interesting account of Lyell out with some Survey men in Dorsetshire,—"We all like Lyell much. He is anxious for instruction, and so far from affecting the big-wig, is not afraid to learn anything from anyone. The notes he takes are amazing; many a one has he had from me to-day. He is very helpless in the field without people to point things out to him; quite inexperienced and unable to see his way either physically or geologically. He could not map a mile, but understands all when explained, and speculates thereon well. He wore spectacles half the day, and looked ten years older. Logan says it is vanity that prevents his always doing so. I think it is custom, and perhaps his wife." Of the meetings of the Geological Society accounts are numerous. There have been changes in the procedure of this body, but in other respects things are much as they were when Ramsay, on hearing that there was a lack of papers, wrote as follows,—"They might have more were it not that authors of theoretical papers are afraid to send them in for fear of the fatherly care of the Council. Green's last paper was quashed by —— in particular. You will see it in the *Geological Magazine*. I have a great mind to send in a paper entitled 'The Wonderful, the Councillor,' with illustrations, by Rutley, of living examples."

We must pick out no more plums, not because it is unfair to the book, for that can well spare a few from its abundance, but because space fails us. Two more extracts only really must be inserted. One shows Ramsay, as Local Director, in the field. "Never was there a more delightful field instructor than he. Full of enthusiasm for the work, quick of eye to detect fragments of evidence, and swift to perceive their importance for purposes of mapping, he carried the beginner on with him, and imbued him with some share of his own ardent and buoyant nature. . . . He would take infinite pains to make any method of procedure clear, and was long-suffering and tender where he saw that the difficulties of the learner arose from no want of earnest effort to comprehend. But woe to the luckless wight who showed stupidity, inattention, or carelessness! Ramsay's eye would flash, his hand would whisk the tips of the curls on his head, he would seize the map and rush ahead, calling on the defaulter to come on and look. And he would keep up his offended tone until he felt that his pupil had at last been made to feel his delinquency. Then some snatch of a song or line of an old ballad or fragment from Shakespeare, appropriate to some phase of the incident, would come into his head, and instantly it would be on his lips with probably a hearty laugh, that showed how entirely the cloud had passed away."

Our last extract shall be the concluding verse of Ramsay's famous Survey song, "The Lay of Sir Roderick the Bold and the Emperor of all the Russias," which is sung to the air of "The Auld wife ayont the Fire." The song relates how the Knight, with De Verneuil and Count Keyserling, went at the invitation of the Czar "to map the rocks ayont the sea, that rise upon the Ural," for, as the Czar said, "'Twill be droll but you will find a bed of coal, and I'll sing Tooralooral."

"Then hame he cam, and left his mates,
And wrote a book wi' maps and plates,
And sections o' the Russian states
Frae Baltic Sea to Ural.
The Emperor he scratched his poll,—
''Tis bravely done! but by my soul!!
I wish we had some beds o' coal!!!
Oh! Tooralooralooral!!!!
There's auld rocks ayont the sea,
There's British rocks ayont the sea
Hae lots o' coal, the worse for me,
There's nane beside the Ural.'
(*Weeps.*)"

Monkeys.

A Handbook to the Primates (Allen's Naturalists' Library). By Henry O. Forbes, LL.D. 2 vols. 8vo. Pp. xvi., 286, 22 coloured plates; pp. xvi., 296, 7 coloured plates, with 8 maps, showing distribution of various genera, and other illustrations. London: W. H. Allen & Co., 1894. Price 6s. each vol.

To those familiar with the rich series of living monkeys which pass from time to time through the gardens of various zoological societies, and those which adorn the cases in our museums, it may seem strange to say that comparatively little is known of this group of animals. But it is a fact that a considerable proportion of the monkeys known to science have been described from menagerie specimens, with imperfect ideas as to their exact habitat and with a still less perfect knowledge of the variations of the individual species which has been described. Numerous examples occur in our museums about which the only information is thus recorded: "From the zoological gardens of ———, purchased of Mr. ———; said to come from ———." And all this imperfect knowledge comes from the fact that the sportsman, filled with sentimental yearning for his kinsmen, hesitates to shoot, and so zoology has to grope along as best it can, except in certain cases. Happily, this state of things is passing, and we are now able to understand with a degree of certainty the Bornean monkeys, for instance, thanks to the careful collecting and observation of Mr. Alfred Everett and Mr. Charles Hose. It is well to insist somewhat on this fact, because until better collected series of skins and skeletons of monkeys from all parts of the world are available, the construction of maps of distribution of this interesting order is almost useless and leads us into grave and persistent error.

We are particularly pleased to see, almost for the first time, this effort to collect together a general and particular account of the Primates between four covers. Especially so, as, from the reasons given above, a hopelessly muddled state of things prevails, and the whole of our present knowledge of the group is widely scattered in literature. This undigested mass of literature Dr. Forbes has now arranged, and despite the obvious signs of hasty writing, and the evidence of carelessness in references, the book will form a valuable basis on which some future zoologist may build up a permanent and an enduring structure.

The work begins with a too brief Introduction, containing the description of a Primate, and passes at once to the consideration of the Lemurs, in which group the author has received considerable and important assistance from Dr. Forsyth Major. These include the Aye-Aye of Madagascar, the Tarsiers of Malaysia and the Philippines, and the true Lemurs of Madagascar, Africa, Ceylon, India, and Malaysia. Of the numerous species comprised in the Lemuroidea, by far the larger number are strictly confined to Madagascar; but the

fact that species also occur in Southern India and Malaysia has caused some zoologists to view with favour the idea of a former land junction between these distant areas. But when we consider the geological distribution of the group, as evidenced by the fossil remains already brought to light, we see that it formerly extended over the land area of Africa and Southern Europe and Asia, and are more inclined to believe that conditions of climate or other causes have determined the present distribution at either end of the earlier extension. Dr. Forbes makes a feature of his geological evidence, and treats of the majority of the remains described by various authors from the rocks beneath us. So far as we know at present, the Lemuroidea appeared in Lower Eocene times, and obtained a considerable development in the Middle Eocene. Zittel has called attention to the fact that in the Upper Eocene of Europe lemuroid genera formed a very characteristic element of the fauna, and the evidence, though less abundant, is perfectly sufficient to permit a similar though not so strong statement as regards North America. By far the most extraordinary of all these fossil lemuroids is *Megaladapis* from Madagascar, an account of which was given in NATURAL SCIENCE (April, 1894, p. 243).

Following on the Lemuroidea come the Anthropoidea (or true monkeys), containing the Harpalidæ and the Cebidæ of the New World and the Cercopithecidæ and Simiidæ of the Old World, both of which two groups are exclusively confined to their own areas. Moreover, no fossil representative of the two former has ever been found in the Old World, nor have any remains of either of the latter families ever been found in the New World, a fact, as Dr. Forbes remarks, which doubtless indicates a separation of great antiquity between the two groups. The chief genera of the Harpalidæ and Cebidæ are those containing the Marmosets, Capuchins, Woolly Monkeys, Spider Monkeys, Howlers, Sakis, and Squirrel Monkeys; and their chief habitat is the extensive equatorial forests of the Amazons, the Orinoco, and their tributaries. It is interesting to note that Mr. Salvin has recorded troops of the Mexican Spider monkey at an elevation of 7,000 feet on the volcano of Atitlan; but as a rule the basal line of a mountainous tract seems to be preferred by these animals. All these New World monkeys are characterised by a flat nose, the opening of the nostrils directed outwards, and the nostrils widely separated by a broad cartilaginous septum; on this account they are designated Platyrrhini. All the Old World monkeys, on the other hand, have the nose narrow, the nostrils close together and directed downwards, as in man, and separated by a thin septum, or partition, of cartilage; and from this peculiarity they have received the name of Catarrhini.

These Catarrhini include the Baboons, and the Guenons of Africa, the Black Apes of Celebes, and the Asiatic Macaques, the curious Nosed-monkeys of Borneo, the Langurs of India and Malaysia, the Guerezas of Africa, and the Man-like Apes. Among the best known forms of the Old World apes are the Chimpanzee, the Gorilla, and the Orang-Utan. The remaining family of the Primates, the *Homo sapiens* of Linnæus, is somewhat better known than the rest, and Dr. Forbes dismisses it in some six pages.

Each genus and species of monkeys dealt with by Dr. Forbes is described in brief but comprehensive terms, and notes are given on its geographical distribution (as recorded), its general habits and characteristics, while a synopsis of the literature connected with it is quoted. When possible, a brief extract from the personal observa-

tions of travellers is also given; these are often of considerable interest, and go far to make the subject inviting to the general reader, as may be seen from Mr. Ridley's paper now appearing in our pages. A somewhat larger proportionate space is devoted to the Simiidæ than to the other groups of monkeys, by reason of their being the most highly-organised and nearest to man in structure; and from the generalities appended to the several species included in the family we recognise, as might be expected, that they are among the best-studied members of the whole group.

Respecting the range in time of the extinct Anthropoidea, the geographical evidence goes to show that they appeared later on the scene than did the Lemuroidea. In South America, the Santa Cruz beds of Patagonia (Upper Eocene or Oligocene) have yielded remains, but in the Old World undoubted monkeys do not appear until the Miocene period. In Pliocene times, existing genera are represented by numerous species. A molar tooth of a form said to be identical with the Orang-Utan (*Simia satyrus*) is recorded from the Pliocene beds of the Sivalik hills, and this is of considerable interest in connection with the flint flake from Burma, of Miocene or early Pliocene age, illustrated in NATURAL SCIENCE for November, 1894 (p. 346); for, if correct, it seems to show that the higher Primates were already differentiated in those early times.

The volumes close with an attempt to show the geographical distribution of the group, limited, of course, by the difficulties to which we have alluded in our opening paragraph. In illustration of this distribution eight rough but useful key-maps are given, and one can obtain at a glance a good general notion of the monkey world.

With regard to the twenty-nine coloured plates, we are tempted at first to rail at the publishers for providing such chalky pictures; but on reflection, and considering the cheapness of the volumes, we come to regard the pictures in a more favourable light. It may be well, nevertheless, to remind Messrs. Allen & Company of the old proverb about the "ha'porth of tar." But in spite of these minor defects we have the message of the monkey people, as Dr. Forbes understands it, and to him, to the publisher, to Dr. Bowdler Sharpe, and to the public, we offer our congratulations on the issue of these volumes.

THE YOUNG COLLECTOR.

BUTTERFLIES AND MOTHS (BRITISH). By W. Furneaux, F.R.G.S. With 12 coloured plates and numerous illustrations in the text. Pp. xiv. and 355. London: Longmans, Green and Co., 1894. Price 10s. 6d. nett.

WE notice with joy, but without understanding, the present publishing "boom" in natural history. Volumes of scientific series lie on every library table, appear in every publisher's catalogue. Many are designed for a scientific public; more for a general public. Of the latter order is the book before us, and we can praise it without reserve. The illustrations, even the coloured ones, are conspicuously good. Nearly every English butterfly, and not a few of the moths and microlepidoptera, are figured.

The first sixty pages are devoted to a general account of the habits, structure, and classification of butterflies and moths. This part is clear, intelligent, and interesting. The only suggestion we should like to make is that a compound microscope is unnecessary for any of the details that Mr. Furneaux mentions. A first-rate platyscopic hand-lens is much more convenient, and the young naturalist

should train himself thoroughly in the use of it. There is no more common error than an undue use of the higher powers of a microscope. Except for the intimate details of histology, a low power or a hand-lens is much more easy to use, and its employment gives a much better idea of the structure.

The directions for catching, killing, and preparing specimens are excellent. We note with great pleasure a clear account of the best method for preparing larvæ. The chapter on breeding is most useful.

With the aid of this book young collectors may train themselves, not merely to make a postage-stamp collection of butterflies and moths, but to study these insects in relation to their natural surroundings and to the phases of their life. We commend it heartily.

Darwinism in the Lecture-Room.

Lectures on the Darwinian Theory. Delivered by the late Arthur Milnes Marshall, edited by C. F. Marshall. 8vo. Pp. xx., 236, with two plates and 35 text-illustrations. London: D. Nutt, 1894. Price 7s. 6d.

It is rather ungracious to complain that a book is too sumptuously turned out, and yet that is what we feel inclined to say with regard to the one before us. We expected a companion volume to that containing the Biological Lectures and Addresses, reviewed in Natural Science for August, 1894; but the present volume is in larger size, on better paper, printed with larger type, profusely illustrated, and furnished, not only with an index, but with an elaborate table of contents occupying ten pages. All these features are praiseworthy, and would doubtless become a book that was "a useful contribution to the literature of Darwinism," and a fitting memorial of the accomplished and lamented Milnes Marshall. But this book remains, in spite of its garniture, neither of those things. Extension Lectures are well enough in their way, but, like the diagrams that illustrate them, they are scarcely intended or fitted for presentation to the public as a permanent possession. For Extension Lectures these chapters and their illustrations were prepared, and on every page they bear the mark of their origin, not to be veiled by beautiful printing or expensive process-engraving.

There is no serious fault to be found with the book. It will serve the turn of the Home Reading Union and such bodies excellent well; and if an occasional lecturer utilises it to supplement his own learning or imagination, as the parsons of an older and a wiser day utilised the homilies of the church, why, no great harm will be done. If, however, we must play the serious critic, as the editor of the book doubtless desires, we will venture an objection to its title. It is an instance of the old and oft-corrected confusion between the fact of evolution and the Darwinian explanation of evolution. We are ashamed to have to repeat that Darwin's contribution to the philosophy of evolution may be summed up in the phrase Natural Selection and its subsidiary Sexual Selection. Darwin of course did more than proclaim these methods of evolution; but what else he may have done is no part of the Darwinian theory. These lectures, however, deal far more largely with the evidence for evolution than they do even with Natural Selection, while Sexual Selection is mentioned only in the two pages that deal with Epigamic Coloration, and then in a cursory manner. What, for instance, is meant by the argument from palæontology or the argument from embryology? These branches of research have never furnished any evidence for Natural Selection, nor can they be expected to do so.

An inappropriate title need not prevent the book from doing good. These lectures are quite as interesting as the fluff that sells by hundreds of thousands, and have the additional merit of sobriety and correctness. They should set right many popular errors. One or two warnings may, however, still be given. It should be more clearly stated that the facts of modern geographical distribution are in themselves no evidence for evolution: on a hypothesis of special creations such facts present no difficulties, and Louis Agassiz was able to use them in defence of his own anti-evolution views; on a hypothesis of evolution, however, the facts do present difficulties, which are to be explained by geology and palæontology on the assumption that evolution has taken place. To bring these facts forward as evidence of evolution is therefore to argue in a circle. Again, one would like to have seen a more cautious treatment of the Recapitulation Theory. Obviously Professor Marshall could not have considered the recent objections raised by Mr. Adam Sedgwick in the *Quarterly Journal of Microscopical Science*, but he might well have discussed the criticism published by Dr. Hurst in our own pages before these lectures were delivered. Possibly he did so, but the notes may not have been preserved. There is little doubt that many of the instances given by Professor Marshall can be explained without the aid of this theory. In fact the author distinctly excludes from consideration those cases which, as some believe, can alone afford conclusive evidence. One of his tests of recapitulation is that "Each stage must be an advance of [*sic*] the preceding one. . . . Intermediate stages, which are not and could not be functional, can form no part of an ancestral series." But there are surely cases in which the descendants are degenerate, not because they are specialised, but because they are actually less able to cope with their surroundings. Why are these cases to be excluded? A decadent which, in its development, shows features characteristic of a more highly-developed ancestry, is a more powerful witness to recapitulation than are all the advanced types put together.

Objections such as the preceding, however, will present themselves only to the serious and professed student, and it is not for him that the book was written, for whomsoever it may have been published.

F. A. B.

Foraminifera.

A Synopsis of the Arctic and Scandinavian recent Marine Foraminifera hitherto Discovered. By Axel Goës. Kongl. Svenska Vet. Akad. Handlingar. Vol. xxv., no. 9, 1894. 4to. Pp. 128, with 25 plates.

Since Rupert Jones and Kitchin Parker published their monograph on the North Atlantic Foraminifera, students of the Rhizopoda have had to piece together the scattered writings on the subject. Now that Dr. Goës has brought out this handsome quarto, taking in, not only the North Atlantic, but the Arctic Ocean and the Baltic Sea as well, we have an up-to-date account of Scandinavian Foraminifera.

Opening his paper with a brief sketch of the various expeditions by which material has been obtained, Dr. Goës makes some remarks on variability among the Foraminifera. He then proceeds with a detailed specific description of all the forms, giving their synonyms, depths, and collective and other details. There are two new genera, one *Crithionina*, a labyrinthine polymorphic sandy form, and the other, *Ceratina*, a *Trochammina*-like form, with a porcellanous test. This latter is from the Azores, 540 metres, and is not a Scandinavian form. The plates are such as we are accustomed to from Stockholm, are drawn

by Goës and Hedelin, and lithographed by Schlacter, and are beautiful; an especially fine figure of *Astrorhiza* occupies plate 1.

AMONG THE CALIFORNIAN MOUNTAINS.

THE MOUNTAINS OF CALIFORNIA. By John Muir. Pp. 381, with 53 illustrations in the text. London: T. Fisher Unwin. Price 7s. 6d.

THIS book contains some excellent studies in natural history, among which, in our opinion, one of the best is that upon the Dipper. *Cinclus mexicanus* is a frequenter of the coldest waters of the sierra, and is one of the few birds that is equally merry under depressing and exhilarating circumstances. Many birds droop and are dull when external nature does not suggest joviality; not so the Water Ouzel, who "both in winter and summer sings sweetly, cheerily, independent alike of sunshine and of love, requiring no other inspiration than the stream on which he dwells." It is one of those birds that are thoroughly at home under the waves despite the fact that, apart from the plump and rounded form of the body, there is no special adaptation to an aquatic life. The feet are, of course, not webbed, and so progression is effected by flying under water as in the case of the penguin. The Water Ouzel is dignified with a chapter all to himself; so, too, is the Douglas Squirrel; but no other beast is thus treated, though scattered through the book are numerous notes and casual allusions. Like "Orpheus at the Zoo," Mr. Muir whistled to the animals, and especially to the squirrels. He sang or whistled "Bonnie Doon," "Lass o' Gowrie," and many other national airs to which the squirrel listened with more than a polite attention. But when, remembering, perhaps, its effect upon the Scotch professor, our author came to the "Old Hundredth," off went the squirrel screaming "his Indian name, Pillillooeet." We are inclined to praise Mr. Muir's book, not only for what is in it, but also for what is not in it. With praiseworthy fortitude, in these days of free and easy generalisation, the author refrains from relating his experiences, if he had any, with living creatures looking like bits of sticks or, like the dweller in the suburbs, trying to appear to be something else than what they really are. However, we must not speculate further upon the "might have been"; and so, with a final commendation, we bid —not farewell—but *au revoir* to Mr. Muir.

RECENT PUBLICATIONS AND PERIODICALS.

MR. MELLARD READE's paper in the last issued number of the *Proceedings of the Liverpool Geological Society*, on the Dublin and Wicklow Shelly-Drift, will be welcome to geologists who want some general account of these deposits, and it will also be valuable as containing careful mechanical analyses of the gravels; that is to say, of the size and nature of the stones composing them. From a biological point of view it is not so satisfactory, for Mr. Reade, like most writers on the subject, ignores the strange mingling of the contained fossils. We observe also that the same fauna occurs at extremely different levels, and that there is no apparent division into zones of depth, such as one would expect in undisturbed marine stratum. A great deal has yet to be done before we can accept such confused gravels as evidence of a "great submergence." How is it that no one has yet found on the lowlands, anywhere in the British Isles, a marine fauna pointing to a depth of 100, or even of 50, fathoms? Such deposits should be common, if there has really been a submergence of 500 or 1,000 feet.

We have received from Mr. C. A. Barber, the Superintendent of Agriculture in the Leeward Islands, a paper on the grasses of Antigua, and the second number of the *Agricultural Journal of the Leeward Islands*, an octavo of 28 pages, published at St. John's, Antigua, price 6d. The journal contains notes on Durians and Gambier in Dominica, two plants native to the East Indies, as will have been noticed by readers of Mr. Ridley's notes on the mammals of Singapore, and now transplanted to the West through the medium of the botanists at Kew. The Durian is a paradox, revolting to the smell but delicious to the taste; a nutritious food, it never palls upon the appetite or injures the digestion. A good description of it is to be found in Wallace's "Malay Archipelago." The fruit grows on a large forest tree, is about the size and shape of a cocoa-nut, has a thick rind with short, stout spines, and its five carpels are filled with cream-coloured pulp. Its acclimatisation in Dominica will be an additional attraction to tourists. *Urucaria Gambir*, which also has been successfully introduced, possesses very valuable tanning properties, and is said to impart an unrivalled softness to leather. The propagation of the plant presents some difficulties; hitherto its cultivation has been "a wasteful one, in that it has formed a catch crop in the Chinese pepper gardens, until the pepper crop was matured." Its establishment at Dominica is expected to be of advantage to the island. We are glad to see, from these and other papers, that the energetic planters and merchants of the Leeward Islands are fully alive to the necessity for truly scientific work in these days of severe competition.

The new edition of the Molluscan portion of Bronn's "Klassen und Ordnungen des Thier-Reichs" progresses slowly but surely. Lieferung 15–17 has just reached us, containing the conclusion of the Amphineura, and the opening chapters on the Scaphopoda (pp. 337–400). It is accompanied by three plates illustrating the development of *Chiton* that are most beautifully executed. As an instance of the way in which the text of the work is brought well up-to-date may be cited the inclusion of Sowerby's new genus *Schizodentalium* with a reproduction of the figures, which appeared in the *Proceedings of the Malacological Society*, pt. iv., pl. xii.—a reproduction, by-the-bye, that is a decided improvement on the originals.

Brill, of Leiden, has published "A Bibliography of the Japanese Empire," by Fr. von Wenckstern. This professes to be, as its secondary title informs us, "A Classified List of all Books, Essays and Maps in European languages relating to Dai Nihon [Great Japan] published in Europe, America and in the East from 1859–93 A.D. [VIth year of Ansei—XXVIth of Meiji]." The book contains, in addition, a facsimile reprint of Léon Page's well-known "Bibliographie Japonaise depuis le xv^e siècle jusqu'a 1859." It is divided into sections, as: Travel, Religion, Philology, Belles Lettres, History, Law, Medicine, Education, Fine Arts, Ethnography, Natural History, etc., and is published at twenty-five shillings.

We learn from *Science Gossip* that the Quekett Microscopical Club has decided in future to issue its journal half-yearly instead of quarterly. The same journal informs us that the *British Naturalist* is dead. *Science Gossip* itself is to be raised in price from fourpence to sixpence a month, and sundry alterations are promised in its pages.

Messrs. Dulau & Co. have sent us a catalogue of works on General Zoology, which they offer for sale.

OBITUARY.

Among the deaths which we regret to record this month is that of Dr. Robert Anstruther Goodsir. Although at first trained as a banker, he afterwards followed the medical profession, in which one of his brothers so conspicuously succeeded. Dr. R. A. Goodsir went as surgeon to Penny's ship "Advice" on a search for Franklin, in whose expedition had sailed his brother Harry. His account of the voyage was a successful book of its time. In 1850 he again accompanied a search expedition for Sir John Franklin. He was a great traveller, but returned to Edinburgh about 1885, and settled down quietly. He died, at the age of 71, in the middle of January.

Dr. Henri Clermond Lombard, of Geneva, the famous climatologist, died at Geneva at the end of January, aged 92. He was born in that city in March, 1803. He studied at Edinburgh University and completed his education in Paris under Andral and Louis, graduating in 1827. His thesis was on Tubercles. In 1856 he published his "Climats de Montagne." His great work, "Traité de Climatologie," appeared between 1877 and 1880. In 1882 he presided over the International Congress of Hygiene at Geneva, and retained up to the time of his death full mental vigour.

Dr. Lewis R. Gibbes died on November 21 at Charleston. He was born in that city August 14, 1810. Educated for the medical profession, he speedily resigned it for that of mathematics, but resumed it again in 1836, when on a visit to Paris. His chief work in natural history was a series of papers on American Crustacea ; but he was also well-known to astronomers, chemists, and botanists.

Dr. Hugo Christoph died at St. Petersburg on November 5. He worked for many years on the Lepidoptera of Persia, Caucasia, Armenia, and the Amur Region. Dr. C. v. Felder, the entomologist, of Vienna, died on November 30, aged 80 years. Mr. E. H. Acton, M.A., Lecturer in Natural Science at St. John's College, Cambridge, died suddenly on February 15. The death of the Marquis of Saporta is announced.

With very deep regret we learn, as we go to press, of the death of Mr. J. Whitaker Hulke, President of the Royal College of Surgeons, which took place on February 19, from pneumonia following influenza.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

The following appointments have recently been made: Mr. F. E. Allhusen, B.A. Cantab., as science-master at Charterhouse, to give instruction in Physics, Chemistry, and Geology; Mr. H. B. Pollard, of Christ Church, Oxford, known for his valuable researches on the morphology of the fish's head, to be Lecturer in Biology to Charing Cross Hospital Medical School, to take which post he will vacate a Berkeley Research Fellowship at Owens College; Dr. Gabriel von Perlaky to be assistant at the Botanical Institute of Budapest; Dr. Filippo Giovannini, to be Chief Conservator of the Royal Botanic Institute in Bologna; Mr. V. K. Chesnut, to be Assistant in the Botanical Section of the U.S. Department of Agriculture; Mr. W. W. Clendenin, professor of geology and mineralogy in the University of Louisiana, to be Geologist of the State. Mr. S. S. Buckman is lecturing on geology at the Agricultural College, Cirencester, pending the appointment of a permanent successor to Professor Allen Harker. The professor is expected to reside in college and to lecture on geology, botany, and zoology. Applications may be sent to the Principal.

The Hayden Medal of the Academy of Natural Sciences of Philadelphia has been awarded to Professor G. A. Daubrée, the well-known author of "Géologie Expérimentale"; Professor Daubrée was born in 1814. The University of Cambridge has awarded the Sedgwick Prize in Geology to Mr. Henry Woods. The subject for 1898 is "The Glacial Deposits of East Anglia." Mr. Philip Lake has received a grant of £50 from the Worts Travelling Scholars' Fund; he will investigate the distribution of the trilobites in Russia and Sweden. Mr. Malcolm Laurie has been appointed to the Cambridge University table in the Zoological Station at Naples for three months. The Regia Lyncei Academia has conferred a medal and diploma of foreign membership on Professor James Hall, of Albany, N.Y.

It is proposed to erect a memorial tablet in St. Ninian's Cathedral to the late Dr. F. Buchanan White. Subscriptions to this end should be sent to Dean Rorison, Perth; or to Henry Coates, Pitcullen House, Perth. Dr. White's "Flora of Perthshire," a work on which he had been engaged for some years, is left in an almost completed condition.

Mr. Brock, R.A., has finished his model of the statue of Sir Richard Owen, which is to be placed in the Natural History Museum. It is said by those familiar with Owen's features to be a perfect likeness. The model will be seen in this year's Academy. The subscription list is not yet full, and Mr. Percy Sladen, of the Linnean Society, Burlington House, will be glad to hear from those interested.

We understand that there is a vacancy in the Museum at Singapore, for which a curator is required. The Museum has been in existence about eight years, and Mr. William Davison was the first curator. A collection of various specimens of natural history had been made by Mr. James Collins previously, and this formed the nucleus of the exhibitions in the museum. Mr. Davison died in 1893, and was succeeded by Dr. Haviland, who resigned the post in a year, since when a clerk has

been employed to look after the buildings and their contents. There is a considerable collection of mammals, birds, reptiles, fishes, and insects, and also a large number of ethnological specimens and minerals. To the curator's duties is added the charge of the lending and reference library, which is in the same building. The salary is 3,600 dollars, with free passage to and from England, and a house.

The thirteenth annual meeting of the American Society of Naturalists opened at Baltimore on December 27. The first discussion was held upon "Environment in its Influence upon the Successive Stages of Development and as a Cause of Variation," Professor Osborn leading, and being followed by Professors Cope and Hyatt. Professor Brooks read a paper on "An Intrinsic Error in the Theories of Galton and Weismann." Professor Cope was elected President for 1895. The retiring President, Dr. Minot, gave an address entitled "The Work of the Naturalist in the World."

The Geological Society of America held its seventh annual meeting on December 27, 28, 29, at Baltimore, in the rooms of the Johns Hopkins University. Professor Chamberlin presided, and delivered an address on "Recent Glacial Studies in Greenland."

Professor Edmund B. Wilson has been elected President for 1895 of the American Morphological Society. At a meeting recently held in Baltimore he read papers on "The 'Quadrille of the Centrosomes' in the Echinoderm Egg; a second contribution to Biological Morphology," and on the "Polarity of the Egg in *Toxopneustes*." Professor Hyatt, at the same meeting, announced his researches upon the "Parallelisms between the Ontogeny and Phylogeny of *Pecten*."

The officers of the "Michigan Academy of Sciences," which was founded at Ann Arbor on June 27, 1894, are:—W. J. Beal, President; J. B. Steere, Vice-President; F. C. Newcombe, Secretary; W. B. Barrows, and I. C. Russel. It has been decided that the Academy shall have for its first object the study of the Natural History of the State of Michigan.

At a meeting of the Zoological Society of London, on February 6, Dr. Holding exhibited a deer horn which had been gnawed by some animal. The general statement of keepers is that deer nibble the horns themselves, especially the hinds; but the appearance of the antler shown seemed to show that the gnawing had been the work of rodents. Dr. Gadow remarked that in Germany it was not unusual for portions of the exterior surface of the antler to be removed by slugs. In the *Journal of the Bombay Natural History Society* (ix., no. 2) the Assistant Conservator of Forests at Nagpur, Mr. P. H. Clutterbuck, writes to say in that district Sambuhr horns are gnawed by porcupines, and he has found such gnawed horns in the "run" of that animal. The natives say the porcupine gnaws such articles for food, but Mr. Clutterbuck thinks the purpose is more for sharpening the teeth.

The changes in the house list of the Geological Society this year are as follows:—General McMahon and Mr. Hudleston become Vice-Presidents in the room of Dr. Hinde and Professor Judd; Mr. Blanford succeeds Professor Wiltshire as Treasurer. The Geologists' Association have lost Mr. Hudleston and Professor Blake as Vice-Presidents, their places being filled by Dr. Hinde and Mr. T. V. Holmes. The Association rejoices in a balance of £16 on their annual account.

Mr. Bayard, the United States Ambassador, was present at the Geological Society on February 15, and received the Bigsby Medal on behalf of Mr. C. D. Walcott, of Washington.

The Liverpool Naturalists' Field Club held their Annual Meeting on January 25. Mr. G. H. Morton, the President, read an Address on the "Recent and Fossil Flora and Fauna of the country around Liverpool." This field-club was the first, or one of the first, started in this country, and by the end of its first year totalled 482 members (1861). Five years later the total membership was 725, while now the membership is under 300. The chief work of the Association all along has been done in Botany.

We learn from the newspapers that the Mitchell Library of Glasgow has received a bequest of £500 from a man who passed as a tramp and who lived in a model lodging house at Vauxhall. The incident is so unusual that it is as well to chronicle it.

On February 13 the Oxford University Junior Scientific Club held its 150th meeting. This club has now been in existence a little over twelve years, and its popularity shows no signs of decreasing. The editor of its *Journal* regrets, however, that the junior members contribute little to the discussions and less to the papers. The Oxford undergraduate still retains a wise dread of making a fool of himself. Among papers recently reported in the *Journal* are an interesting account of *Opisthocomus* by Mr. Pycraft, and a note on the use of certain Aniline Stains by Mr. R. A. Buddicom, which should prove of service to the histologist. Should this meet the eye of any old members of the Club, we hope it will induce them to subscribe to the *Journal* the small sum of 5s. per annum. Its editor is now A. W. Brown, Christ Church, Oxford.

The third International Zoological Congress will be held at Leyden in September. Those intending to join should write to Dr. P. P. C. Hoek, Helder, Holland.

The eleventh German Geographical Congress will be held in Bremen, April 17 to 19. Dr. W. Wolkenhauer, Laagenstrasse 44, Bremen, is the Secretary. The special subjects for consideration are:—"Polar Exploration, especially the state of the South Polar Question"; "Oceanography and Maritime Meteorology, as well as the development of Charts"; "Commercial Geography"; "Geography of the German North Sea Coast"; "School Geography."

The American Museum of Natural History, New York, has purchased the unique collection of fossil mammalia made by Professor E. D. Cope, of Philadelphia. The Museum thus acquires a valuable series of type specimens, and increases the already important addition of fossil mammalia made to its collections since Professor H. F. Osborn assumed the direction of the Department of Vertebrate Palæontology.

The Museum at Hastings, originally opened in August, 1892, has recently undergone some alterations, and was re-opened in January by Lord Brassey. The alterations have permitted the symmetrical grouping of the exhibits under two heads, the works of nature and the works of man. The authorities of this Museum are in full accord with the modern spirit, and endeavour to exemplify the history, the industries, the geology, the botany, and the zoology of their own district. Among the natural history exhibits may be noted collections of Wealden fossils, of bryozoa, and of hydroids, made and arranged by Mr. P. Rufford, whose fine collection of Wealden plants was recently acquired by the British Museum; a collection of invertebrata, mostly marine, presented by the Rev. J. W. Tottenham; good collections of birds and British lepidoptera. We learn from the Report that "For educational purposes it is proposed to start a special section in connection with a zoological laboratory, which has now become the usual supplement to a museum. A portion of the museum will be screened off for the use of teachers and pupils, and to be used for the display of specimens stored in chests of drawers." We have so

often insisted on the need for greater co-operation between educational and museum authorities, and especially on the advantage to a museum of a properly appointed laboratory, that we are delighted to learn that such has become "the usual supplement to a museum"; hitherto we had been sadly unaware of that fact. At any rate the Hastings people are shining examples. The Secretary to the institution is Mr. W. V. Crake, Highlands, St. Leonards.

In imitation of the Yorkshire naturalists, those of Lincolnshire have formed themselves into a union, which, if we may judge from the first volume of *Transactions*, kindly sent us by the organiser and late secretary of the union, Mr. Walter F. Baker, seems likely to do good work. It is not, we gladly read, the ambition of the Lincolnshire naturalists, "to record new species, or find new localities for species already recorded"; nor do they sympathise with the mere laboratory microscopist. They wish to unite the best work of the two classes. They want, as Professor Miall says in his admirable article, "*live* Natural History." The presidential address by Mr. John Cordeaux attempts to define the faunal areas of this large and diversified county, and gives useful hints for future work. Mr. F. M. Burton lists the chief writings on the geology of Lincolnshire, and urges the formation of a Boulder Committee to work in connection with that of the British Association. A vigorous attempt is being made to found a museum in Lincoln, a city which has allowed many famous treasures to elude its grasp for the want of such an institution. And already the union has done yeoman's service to British natural history, for we are told that an application has been made on its behalf to the Lindsey County Council to protect the coast area under the Act of 1894 relating to birds' eggs, and the Council have agreed to it unanimously. The area thus protected extends from the northern end of the Lincolnshire coast down to Boston; and if the County Council of Holland follow suit, the whole of the coast area of the county will be protected. We congratulate the union on its start. *Macte virtute!*

On Saturday, February 2, the Duke of Westminster opened the Chester Museum extension. In the course of his address he referred to the opening of museums on Sunday, and stated that he "had always considered Sunday as the only day on which many of his fellow-citizens could see such collections." Chester has always kept up its reputation as a centre for local scientific research, and the energies of Mr. Newstead are admirably directed towards the continuance of that useful work.

Speaking at the Birkbeck Institution, on the occasion of the distribution of prizes to successful students by the Duke and Duchess of Devonshire, on Wednesday, the 13th ult., Mr. Justice Bruce dealt at some length on the great utility of the British Museum as a means of spreading education of the highest possible order among the inhabitants, not only of the metropolis, but of the United Kingdom. He paid a splendid tribute to the officers of the Museum, who, he said, were always willing to impart the great stores of knowledge they possessed to those seeking it.

We regret to learn that that valuable publication, the *Index Medicus*, is likely to come to an end for want of funds. To enable it to continue, it requires 500 new subscribers at £2 a year. Surely among medical men enough have attained to such prosperity as will enable them to support a work of such practical service to their profession.

Apropos, we learn from the *Revue Scientifique* that, in France, Mr. Marcel Baudouin, general secretary of the *Association de la Presse medicale française*, has founded a circulating library of medical literature, from which the local practitioner can borrow the works of which he may be in need in return for an annual subscription of 20 francs and a small sum of "caution money," varying with the value of the books. Mr. Baudouin has also organised a bibliographic service similar to those for the benefit of zoologists and botanists to which we have recently referred

in our columns. References are grouped according to the various specialities of medical art. In addition to the mere references, Mr. Baudouin hopes to add soon a special service of abstracts and translations. We do not know if foreign subscribers are admitted; but if so, we should recommend English students and practitioners to avail themselves of this praiseworthy organisation.

WE learn from the *Eastern Evening News* of January 26 that the old tower of Eccles Church on the Norfolk coast is no more. Famous to geologists from the writings of Lyell, it has borne witness to the encroachments of the sea along our eastern shores. Originally placed on the marsh inside the dunes, it was gradually overwhelmed by the advancing sand, so that when sketched by Lyell in 1839 it was in the midst of the sand-hills. As the sand drifted inland the tower was left standing on the foreshore, with the basement portions of the nave showing amid the sand and shingle of the beach. Year by year, notwithstanding the efforts to protect the coast by means of groynes, the tides have beaten more and more often against the church, so that nothing but the substantial architecture and the foundation of tough boulder-clay have enabled it to survive so long. During the storm of January 23 the sea dashed furiously against the tower, the spray of the breakers going at times over its summit. Eventually, the fabric was overthrown, splitting in two in its fall, and now all that is left of it are huge masses of masonry lying about in strange confusion.

FURTHER details have been received of Lieutenant von Götzen's expedition across Africa from Pangani, opposite Zanzibar, to Banana at the mouth of the Congo. The journey occupied only a little over thirteen months, viz., from October, 1893, to December, 1894. The main new results were in the exploration of the group of mountains named Mfumbiro, to the south of Ruwenzori. This was first seen by Speke, but most of our knowledge of it is due to Stanley. Lieutenant von Götzen finds it to consist of a group of five peaks, one of which, Virungo, is an active volcano. He discovered a new lake which is of interest as the source of Ruzizi, a river well known in the old controversies as to the connection of the Tanganyika and the Nile. This river was claimed by Livingstone as an outlet from the lake, but Stanley demonstrated that it is really an inlet. Lieutenant von Götzen reached this district by ascending the Kagera river and then following the Lowa through the forest region to the Congo.

Globus informs us that an expedition has been sent by King Menelik of Abyssinia to the lakes Suai, Hogga, and Orrorecha. Lake Suai lies in a volcanic tract, and supports on its islands a population of about 1,000 Christians who had fled the persecutions of Mohammed Granye. Two streams feed the lake, the Maki from Guraghi, and the Katara from the Albaso plateau. The three lakes are connected together, but Orrorecha is salt; all three are said to drain into the Indian Ocean by the Wesa (Webi-Sidama).

Johannes, a German, succeeded in visiting Balball or Dalubi lake, at the western foot of Mt. Meru. It was found to be 1,260 yards N.N.E. S.S.W. long by 875 wide, is situate on a hill 200 feet high, and is enclosed by steep cliffs.

Mr. Donaldson Smith has been turned back by the Abyssinians in Gallaland and has had to partially retrace his steps. He hopes, however, finally to reach Lake Rudolph, though it is slow travelling with the camels in the hilly regions.

DR. SVEN HEDIN writes to the Geographical Society from Kashgar, November 9, respecting his explorations between Mustagh-ata and Kashgar. He has constructed a topographical map, collected rock specimens, and made geological observations which will complete the researches of Bogdanovich. Hedin intended to start for Lob Nor in December; he will cross the Tarim Desert. He has decided not to attempt to get to Lhassa, but will deal especially with the geology of the Kuen-Lun range. Mrs. Bishop reached Pekin, after a journey from Seoul through Moukden, in October; a postscript dated November 24 shows that the traveller was at Vladivostock. Mrs. Bishop hopes to return to England in April.

CORRESPONDENCE.

"Trinomial Nomenclature of Plants."

(This volume, p. 6.)

As is so often the case with people who are anti-anything, your anti-trinomialist does not appear to have learnt what the system he attacks really is, but to have confused the shadow with the substance. Trinomialism is not, as he and other opponents seem to think, simply the putting of three names in a row, but is the system under which races, especially *geographical* races, thought to be of less than specific rank (not aberrations, individual variations, and such like), receive distinctive Latin names in addition to their specific ones. Whether "subsp." is or is not inserted between the second and third terms of the series is exactly of the same importance—*i.e.*, *nil*—as whether we write "*Homo sapiens*" or "Gen. *Homo* sp. *sapiens*" on the binomial system. The latter way of writing the name is just as much trinomialism as the former, and "*H. sapiens* subsp. *mongolicus*" is as much trinomialism as "*H. s. mongolicus*."

That when left out, the word understood should be "subspecies" goes without saying, and the vagaries of individuals who think of, and then leave out, any other word, or don't think at all, no more condemn trinomialism itself than those of wild and careless "species" makers do the binomialism under which we all work.

O. T.

The Rosy Feather-Star.

Strictly speaking, it was, no doubt, inaccurate to use the phrase "floating colonies" with reference to this animal. That phrase was used to bring out the facts of its gregarious habit and its power of flotation or movement from place to place. These facts are presumably unquestioned by "Paddy from Cork," so that the creature still seems an adequate disproof of Mr. Drummond's dictum, to wit, "The mere fact that animals cling to one another, live together, move about together, proves that they communicate." Jesting "Paddy" may now answer his own question, if he think it worth while; but, an he will stay, he may learn of another mode of occurrence in addition to the three that he has noted himself, and apparently imagines to exhaust the possibilities. Dr. J. Gwyn Jeffreys, a dredger of some experience, wrote in the *Geological and Natural History Repertory* for 1866 (p. 306), "I have myself seen a number of *Antedon Celticus* clinging to the rope several feet from the dredge when it was taken up from about 60 fathoms . . . no part of the rope lay on the ground." Is it not probable that these numerous Feather-stars were floating at a few feet from the bottom, and that they grasped hold of the rope as it came in contact with them?

F. A. Bather.

The Bird's Foot.—A Correction.

In Natural Science for September, 1894 (vol. v., p. 208), I had the misfortune to state that the deep plantars of the Trochilidæ were schizopelmous, as in Passeres. This is incorrect, for there is a short branch connecting the *flexor longus hallucis* with that branch of the *flexor perforans digitorum* which runs to the second digit. No one regrets this blunder more than myself; it probably arose from my severing the minute, anastomosing branch, in clearing away the connective tissue where the deep plantars cross.

Washington, D.C., U.S.A. Frederic A. Lucas.

January 15, 1895.

ANLAGEN, RUDIMENTS, AND BLASTS.

DR. HERBERT HURST, even though he adduces learnedly the Latin derivation, does nothing to clear the issues. To include Darwin among "ignorant blunderers" may be a triumph of scholarship; it does not affect the fact that for all future time he has impressed upon the English word "rudiment" the general idea of incompleteness to the exclusion of distinction between incompleteness that is vestigial and incompleteness that is incipient. *Litera scripta manet*, at least when Darwin is the writer. Personally I think it a convenience that we should now have a word expressing incompleteness without prejudice to the nature of the incompleteness. The word "vestige" admirably expresses reduced or degenerate completeness. There is wanted a word to express incipient completeness, especially in the familiar case of embryonic incompleteness. Whether or no my suggestion "blast," with its obvious reference to the mesoblasts and the epiblasts, will serve, remains to be seen. I wrote my article "Anlagen" to invite comment on the point; and I am indebted to Dr. Hurst for his criticism, although it seems to me barren.

P. CHALMERS MITCHELL.

THE USE AND ABUSE OF NAMES.

THE question which I raised in your January number is too important to be buried under a rhetorical blanket. The point which I made was a very simple one. In the year of grace 1894 two distinguished naturalists, to both of whom science is under deep obligations, describe *the same skins preserved in the same museum*, and give more than sixty per cent. of them different names.

My contention is that, inasmuch as names are meant to assist men in arranging and finding their knowledge, this can only be justified on the ground that it is wise to have as many indices to knowledge and as many plans of naming and arranging facts as there are naturalists.

I am not so unreasonable as to suggest that when forms increase, especially when the increase is rapid, we must not modify our nomenclature; but in the case I mention there was no increase of forms. The very same skins in the very same museum are given different names in the very same year. If a roll call of the lizards is made next year in the Limbo to which lizards go, no lizard will know what his name is, and there may be grave confusion in that tropical region where salamanders ought to be happy. It will be much better to read out "a mere list of numbers"—a solution which startles you—than having to search for the personality of "the old serpent" in a dozen scientific lists. The cause of our trouble is very largely due to the factitious and quite absurd credit which was supposed to attach, until a short time ago, to the man who was not merely lucky enough to give us some new facts, but wicked enough to introduce a new name, especially a new generic name, without a real necessity, and from some wanton craving for notoriety.

This absurdity is now largely obsolete, and, instead of a wreath of olive, a scorpion is the prize which most sensible people would award to the man who coins an unnecessary name, and loads our groaning memories with additional burdens.

In your remarks you distinguish between a privately-issued book and a book published by a museum. I can make no such distinction. When a book is published it is no longer a private matter, and the man who, either from deliberate motives, from ignorance, or from carelessness, adds books to the world which distort or confuse our knowledge instead of illuminating it, is a scientific criminal.

You add that it would be intolerable if in a catalogue published in a museum or in a museum collection such discrepancies of nomenclature as I have mentioned were to occur. Don't they occur? I know one very large museum (the best and the best-arranged museum altogether in the world) in which there are some very curious examples of labelling the same creatures with different names. This is the case both among fossil and among recent specimens, but it becomes rather epidemic when fossil and recent specimens are examined together. This, however, involves another issue to which I should like to call attention in your pages some time, namely, the

mischief of separating fossil and recent forms into two entirely different categories under different care and custody, and named and arranged by men differently trained and having a different scheme of nomenclature. This issue I will, however, reserve, merely stating here what is a perfectly well-known fact, namely, that a number of fossil so-called species are as much entitled to the distinction as are the mummified Pharaohs of ancient Egypt. A mummy, no doubt, looks very different to a "nice fresh corpse," as a humorist once remarked, and a periwinkle in Clare Market looks different to one from the Crag, but it does not follow that in either case we should have a different name for the two forms. When a sweep is washed he may still be a sweep, and it is best to call him so.

HENRY H. HOWORTH.

P.S.—I am pleased to have just received a letter from Señor Herrera, of the National Museum in Mexico, ardently supporting the position I have taken.

H. H. H.

ERRATA.

THIS volume, p. 142, line 4: for "Watken," read "Wathen."

Page 139: Mr. J. E. Duerden was never Assistant in the Museum of Science and Art at Dublin, but Demonstrator in Biology and Palæontology at the Royal College of Science there.

Page 76: Mr. G. F. Harris desires us to state that the comparison of a silicious sphere from the Yellowstone to *Parkeria* was not made by him, as might be inferred from our editorial note.

CHANGE OF ADDRESS.

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